This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.
+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.
+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.
+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at http://books.google.com/

NEW YORK
PUBLIC
LIBRARY

company's annual for 1910 reports $101,000 paid for mining property, including $30,000 paid for the Shawmut group of claims, but makes no mention of $75,000 paid for the Barnsdall-Pay Roll group, nor of 6,650 shares of Utah Copper stock subsequently given to Barnsdall in payment for ores surreptitiously taken from his property prior to its purchase. The delivery of these shares, however, did not effect the company's immediate cash resources, and is only mentioned incidentally as of possible interest to any remaining outside shareholders. In addition to the foregoing, because of its inability to dispose of any more shares in the public market, the company borrowed $2,500,000 upon an issue of 6 per cent bonds, issued in the name of the Bingham & Garfield Railroad Co., the principal and interest being guaranteed by the Utah Copper Company, which of course is the sole beneficiary, the amount being a first lien upon all of the property of the Utah company and exchangeable for its shares at $50 per share.

An inspired item in one of the company's apparently subsidized papers—the Salt Lake Evening Telegram—of September 13, instant, and repeated the following day, gives the total cost of its Bingham & Garfield railroad as "more than five millions of dollars," which sum is doubtless several hundred thousand dollars below the actual amount which will have been consumed before complete equipment of this spectacular and unnecessary undertaking.

In addition to the foregoing the cost of "stripping" and removal of the overburden for the years 1910-11, together with the construction of several miles of switching tracks and the purchase of twelve or fourteen additional steam shovels, are yet to be provided for. The total cost of stripping, right-of-way and general expense for the year 1910 is stated in the anual report for the year at $1,260,666.31, of which amount $272,674.58 was charged to "operating" account, leaving a balance of $979,991.73 as a charge against the fund arising from the sale of shares to the Hayden, Stone & Co. "pooled interests" before referred to. The manager's report for the year 1910 states that "the total capping removed from both the Utah and Boston areas was 2,814,764 cubic yards." Therefore, by dividing the balance of $979,991.73 which remained after deducting the sum of $272,674.58 as "prepaid expense ore stripping" from the total cost of stripping, we find that the balance of the net cost of stripping per cubic yard was a little more than 39 cents.

The second quarterly report for the current year states that "there was removed from both the Utah and Boston groups a total of 1,395,504 cubic yards of capping," and that for the first quarter of 1911 957,149 cubic yards were removed, the total for the two quarters ending June 30 being 2,352,649 cubic yards which, at 39 cents per yard, gives a total net cost of $917,533.11, all of which sums aggregate a total or $9,056,024.84, exclusive of the sum of $2,100,000—floating debt—carried over into the year 1910. At the present rate of stripping the foregoing debt will on that account—at the close of the year—have been further increased by at least $1,400,000. SO THAT AT THE END OF THE YEAR 1911 THE ACCUMULATED DEBT WILL HAVE REACHED THE STUPENDOUS SUM OF $10,406,000, EXCLUSIVE OF ANY FLOATING DEBT which may have existed at the close of the year 1909.

In view of the foregoing facts it is not surprising that frantic appeals to the public should constantly arise from the quivering sheets that compose the company's publicity bureau, nor that this hungry squad should be augmented by volunteers from the impoverished field of so-called technical journalism—because, here the labor is light and compensation liberal, all "copy" being supplied from the main office.

Among the most recent recruits to the chorus of claquers is the Mining and Scientific Press, published at San Francisco, California, and controlled by T. A. Ricard—an "extinct" mining engineer—and the Mining Magazine, published at London, England, and edited by the same Mr. T. A. Ricard. The first requirement exacted of applicants seeking to enlist in the pie brigade seems to be vigorous denunciation of this journal and Col. Wall, former owner of the mining property comprising the principal holdings of the Utah Copper Company. Up to the present writing Geo. L. Walker, editor of the Boston Commercial and WALKER'S WEEKLY COPPER LETTER, occupies first place at the pie counter, he having displayed extraordinary versatility and refinement in the use of libelous expletives, as well as unctious appeals to the public to buy Utah Copper shares at any price. Ricard's opening remarks give promise that he will soon become a close second.

The following is from the pen of Mr. Ricard and appeared in his London Mining Magazine of August 11, 1911:

Among publications furnishing useful information on mining and metallurgical progress is Mines and Methods, a monthly journal published at Salt Lake City, Utah. It is now nearly two years old and is thus our contemporary in the literal as well as the literary sense. During these two years this Western American periodical has

provided a considerable quantity of technical information, which would have inspired greater confidence if obviously it had not been used chiefly as a stone to hurl at the head of the Utah Copper Company. Even a casual glance at the pages of Mines and Methods shows that its chief purpose is to attack the personnel of the management controlling the biggest copper enterprise in Utah. This vendetta is inspired by Colonel E. A. Wall, whose Improved Ore Jigger also furnishes a subject for the principal page of advertisement. Into Colonel Wall's quarrel with the Utah Copper we shall not probe, for we have no clear notion of its underlying cause, any more than that which prompted the violence of a verbal attack, duly recorded in Mines and Methods, made by the editor, Mr. Claude T. Rice, against Mr. D. C. Jackling, the general manager of the supposedly objectionable company. In the interests of technical journalism, however, we do not hesitate to say that technology ought not to be used as a cloak for a private quarrel. Notwithstanding the obvious merit of many of Mr. Rice's writings they are unreliable for the simple reason that so many of them are prepared not so much to give interesting technical data as to serve as a catapult against the Colonel's enemy; in short, they are not trustworthy. As now conducted Mines and Methods ranks with a broker's circular.

Our readers will search in vain the pages of Mines and Methods to find any justification of the allusions to Col. Wall contained in the article above, and as to Mr. Rice: his relations to this magazine were completely terminated in the month of May, 1910—seventeen months ago—which fact was published at the time in Mines and Methods. And in fairness to Mr. Rice and this journal it may be said that during his employment as editor none of the comments upon or discussions of the Utah Copper Company's mines, management or methods, which from time to time appeared in this publication were written by Mr. Rice, excepting a certain illustrated description of the Garfield mill and an account of a certain controversy which arose between Mr. Rice and Mr. Jackling in the latter's office. Mr. Rice was in the field the greater portion of the term of his employment, visiting the mines of Arizona, Mexico, Nevada and Montana, and his work was therefore almost wholly of a technical and descriptive character, in which field he has few equals and no superior.

Before his engagement with this journal Mr. Rice for several months occupied the position of assistant editor of the Mining and Scientific Press, under the same Mr. Ricard, and it now seems probable that Mr. Ricard, in the article above quoted, has taken occasion to even up some old scores or jealousies and at the same time pave the way to the favor of the management of the Utah Copper Company.

Late developments indicate that Mr. Ricard's California journal will shortly open up for the Utah company with the publication of the result of a purported personal inspection of its properties by one of its staff who recently visited the property, and which will as well supply necessary material for Mr. Ricard's London publication, thus providing real "hot stuff" for consumption of his London constituency, who are being quietly advised to "load up" on Utah, Chino and Ray Con.

It may not be amiss at this juncture to remind our English readers that Mr. T. A. Ricard, editor of the London Mining Magazine and chief owner of the San Francisco Mining and Scientific Press, is the same T. A. Ricard—late mining engineer—upon whose report the INDEPENDENCE MINE, situated at Cripple Creek, Colorado, was bought by credulous English people who paid therefor the very comfortable sum of $10,000,000. The sequel to this transaction, as told by numerous credible persons resident of Cripple Creek at the time, is briefly as follows: It appears that upon conclusion of the sale an English gentleman was placed in charge of the business management of the property with A. Chester Beatty—brother-in-law to Mr. Ricard—as assistant; that in order to insure a permanent market for the ores at a price and upon terms satisfactory to the management, a contract was made with a prominent "ore sampling and reduction company" which provided for the sale of the product of the mine to that company for a period of four years, it being specifically provided in the contract that the PURCHASER should sample and thereby determine the value of the ore and the price per ton to be paid therefor. This method, it appears, was thought to be necessary because of the fact that frequent complaints had theretofore been made by other shippers to the effect that dishonest returns had been made by this and other sampling companies, so that it was often charged that it was impossible for small shippers to secure anything like the true value of their ores; and therefore, to avoid dissatisfaction and dispute in respect to the price to be paid for the ores of the Independence mine, it appears that the entire responsibility of DETERMINING THE VALUE AND THE PRICE TO BE PAID was—by the contract—IMPOSED UPON THE PURCHASERS.

This method—according to the evidence at hand—worked to the entire satisfaction of all parties IMMEDIATELY concerned for some three years and until the fact was noticed by some of the inquisitive English owners that the grade of the ore, as shown by the report of sales, was running very much below the estimate of Mr. Ricard, upon which the property had been purchased. In fact ores, indicated by the report of Mr. Ricard as having an average value of $200 per ton and over, were uniformly returned as of the value of only

$20 to $30 per ton. These allegations were naturally disquieting and finally led to open charges that the mine had been "salted," and of course the blame at once attached to Mr. Ricard who, without much delay, admitted that deception had been practiced upon the English purchasers but was able, it appears, to convince them that he had been imposed upon and deceived by subordinates employed by him in sampling the mine. As a result of the exposure, however, Mr. Ricard severed his connection with the property and publicly announced his retirement from the practice of mining engineering —a resolution which he has faithfully observed ever since. It appears that Mr. Ricadr's brother-in-law, Mr. Beatty—who had become disgruntled at his kinsman—reported inside conditions to John Hays Hammond, then in the service of the Venture Corporation, the purchaser, who at once proceeded to Cripple Creek, ousted the delinquent management (with the exception of Beatty), and declared void the contract upon which the ores had been disposed of—and to which the "sampling and reduction company" meekly submitted, although the contract had then still something more than a year to run.

It may be significant to note that, upon the assumption of the management of the property by Mr. Hammond, it is said that the grade of the ore simultaneously increased to a point approaching approximately the original value represented by Mr. Ricard. So that, as we are informed, our English friends have practically since recouped their supposed loss and are in a fair way to eventually reap a handsome profit. It is said, also, that the company which purchased the ores of the Independence mine, NOTWITHSTANDING THE HARSH TERMS OF THE CONTRACT BEFORE ALLUDED TO, were able—through the exercise of exceptional metallurgical skill—in the short space of three years to clean up about $6,000,000, besides gaining a knowledge of the treatment of low-grade ores which has enabled them to secure almost a monopoly of our newly-discovered "disseminated" porphyry ores. It is worthy of note in this connection that this little band of metallurgical wonders guard the secrets of their Cripple Creek success with more than brotherly solicitude, so that any member of the original group may command the support of the whole on any occasion, for any purpose or adventure; so solicitous are each of the members for the common weal and so fearful are they that in some unguarded moment these precious metallurgical secrets may be lost, that they never violate the compact under which they "stand together."

Upon his retirement from the profession in which he had acquired prominent distinction Mr. Ricard invested a portion of his savings in the purchase of the New York Engineering and Mining Journal, valued at some $500,000 and which, becoming unprofitable, or uncongenial, he sold. Subsequently he bought the San Francisco Mining and Scientific Press, but finding the duties of editing this small sheet too circumscribed, he took up his abode in London and began the publication of the Mining Magazine, the services of which have evidently been called for by his erstwhile metallurgical friends. We shall endeavor to keep our readers informed of the progress of Mr. Ricard's labors in behalf of the Utah Copper Company in its efforts to distribute its shares among our English friends.

FRIENDLY RELATIONS STRAINED

We regret to note that the friendly relations which for many years have existed between D. C. Jackling, general manager of the Utah Copper, Nevada Consolidated, Chino and Ray Consolidated companies, and Mr. George O. Bradley, mechanical and constructing engineer of the Ray Consolidated company have become strained and that, in consequence, Mr. Bradley has been—or will shortly be—relieved by the manager.

It appears that the Ray Consolidated mill—which in minutest detail was modeled after the original Copperton and Garfield mills—has failed to meet the expectations of Manager Jackling, notwithstanding the fact that the designs and plans upon which the mill was built were as ordered by him. It now appears —much to the surprise of the manager and "Metallurgist" Janney—that serious metallurgical complications have developed in the minerological structure of the Ray Con. "disseminated" ore which renders it stubbornly refractory and unyielding to the Utah Copper method of concentration and that Mr. Bradley is held to be responsible for the unsatisfactory conditions that have resulted therefrom. But we have good reasons for believing that Mr. Bradley is entirely blameless in this regard.

The facts are that the methods originally employed at the Garfield mill have been quietly undergoing changes in order to conform to the more modern and sane methods so persistently urged by Col. Wall previous to his resignation from the directorate of the Utah company and that the nature of these changes, which have proven to be the salvation of the Utah company—if there be any—have been concealed from Mr. Bradley as well as the public. So that, the Ray Con. mill now proves to have been constructed upon the plans of a discarded system, and therefore does not conform to the requirements of metallurgical advancements now in partial use at the Magna plant.

We shall watch further development with much interest, but offer the suggestion at this time that a solution of the difficulties probably lies in the adoption of some process of leaching, in which event, however—to insure any degree of success—it will be necessary to secure the services of a REAL metallurgist.

operations the company will mine and treat ore averaging between 1.55 and 1.75 per cent copper; and in the remaining 35 or 40 years of its career it will work on ore running from 1.15 to 1.45 per cent. There is every prospect, however, that operating costs per ton will be reduced and the percentage of values recovered will increase more rapidly than the grade of the ore will decline. With copper selling at 12½ cents, therefore, the profit realized on a ton of 1.25 per cent ore will probably be greater 40 years hence than it is on 1.60 per cent ore now.

As has been explained previously, the Utah Copper company is laboring under many disadvantages at present which will be overcome and eliminated one after another. The area from which it gets its steam shovel ore is so small that blasting and the switching of trains cause frequent delays and loss of time. When five or six times as much ore has been completely stripped, and this will be accomplished within a year, elimination of delays will reduce the cost of steam shovel mining at least 10 per cent: and there will be a further reduction in costs due to the decrease in the percentage of all the ore extracted that is mined underground.

Through the operation of its own railroad the cost of getting a ton of ore from the mine to the mill will probably be reduced 17 cents, equivalent to three-quarters of a cent per pound of copper produced. The railroad is completed from the mine to the Magna plant, 17½ miles as compared with 27 miles by the road now used. It is a magnificent line, having several tunnels, big steel bridges, a splendidly ballasted roadbed, few curves, 90-pound rails, commodious terminals and a maximum 2½ per cent grade in favor of the load from the mine down to the mill. The beginning of operations is being delayed by the difficulty the trunk lines are experiencing in transporting the immense locomotives, the largest ever built, from the shops in the East to Salt Lake City.

About 2,200 men are employed at the Utah Copper mine, and approximately 50,000 tons of capping and ore is being moved daily, or 23 tons per man. Of this amount 13,000 tons is ore and 37,000 tons is stripping. It will thus be seen that the company is working for the future more than the present, as there are three and a third times as many tons of ore in the property as there are of stripping to be removed. The thickness of the capping is so great and its position such, on the side of a steep mountain, that it cannot be removed acre by acre as the ore is needed; but it must be stripped over a very wide area and benched back to make room for many steam shovels, and to overcome the possibility of caving such as would tend to mix the capping with the ore.

The engineers' figures indicate that 37,500,000 cubic yards of stripping will have to be removed to uncover the ore body fully and provide necessary stopes along the rims to permit of its complete extraction. Of this amount 29,000,000 cubic yards lies on the ore and 8,500,000 in the slope areas.

So far 9,385,000 cubic yards of stripping, or between 25 and 30 per cent of the whole, has been removed, equivalent to uncovering over 60 000,000 tons of ore. Only 13,500,000 tons of this ore has been excavated and treated. This means that about five times as much ore has been stripped as mined. So far this year 15,000,000 tons has been uncovered and only 2,500,000 mined, a ratio of six to one. This great amount of advance stripping is being done to prepare for a larger daily production and consequent lower costs.

The prediction that Utah Copper will be able to produce its copper at a gross cost of six and a half to seven cents a pound after another year of stripping and preparatory work are based upon actual deductions conservatively made from results now being accomplished. These figures are arrived at by subtracting the savings to be effected by operating its own railroad, running its concentrators at full capacity, the higher average recovery of values throughout that has been demonstrated on four sections of the Arthur mill, a more advantageous utilization of labor at the mine through the elimination of delays and the reduction of smelting penalties by classifying and cleaning the concentrates. A careful summary of these several items indicates a coming reduction of more than a cent and a half per pound in the company's cost of making copper.

Reference has been made in the foregoing to underground mining. About 3,000 tons of ore is being taken out of the Boston Consolidated ground daily. It is mined in an area that will be stripped and steam shoveled later on, and sufficient broken ore is left in the stopes, therefore, to prevent the capping from caving. The pillars, also, are left intact. About 330 men are employed underground, the ratio of extraction being eight tons daily per man for all miners and surface men in this department.

Some time ago I wrote an extended article on Utah Copper in which I reviewed its financial operations from the beginning and presented figures to prove that the company has paid all its underground development and stripping expense, and its dividends, also, out of net earnings. The article was written for those who want reliable information; it was criticized by those who don't.

One critic declared there was nothing at the mine to account for the $809,251 expended on plant at the mine, including shops, dwellings, etc., but a machine shop and a few other unimportant buildings. Statements of this character are so misleading that it is difficult to credit one making them with honest intentions. When I was at the mine I saw 22 steam shovels, 400 ore cars and 45 locomotives, the first cost of which must have been $1,000,000, and beside churn and air drills, compressors and the other equipment. I assume, also, that the cost of its water works and teams went into the construction account. All these things cost a lot of money, and they are not accounted for in any of the other items presented.

In every mining district where big porphyry mines are being developed I find a number of nice old gentlemen who do not believe these companies will ever make a dollar of profit. These men are pioneer miners who have spent the best portion of their lives hunting for high grade ore, rich enough to mine with elbow grease and send to market on the back of a mule. They were brought up to believe that low grade ore was worthless, and it takes more than a lot of churn drills, steam shovels and big concentrators to convince them to the contrary. Having been educated to small things, they are unable to grasp and comprehend the enterprises of great magnitude that are being worked out by younger men.

These old gentlemen are entirely harmless, except when they use the money they receive for proper-

their hands, have been materially improved; but the crowning absurdity in engineering mimicry still goes on with ever-increasing vigor. Twenty-four steam shovels are now required to provide the daily supply of ore for the mills, where less than half that number were needed two years ago to secure an equal quantity. And all these are supplemented by several hundred underground miners who supply nearly double the quantity of ore that was obtained from that source two years ago, at which time stockholders were assured that by the close of the year 1909 all underground mining would practically cease.

We have shown repeatedly—and the fact is apparent to every disinterested engineer who has visted the premises—that profitable extraction of this ore by means of steam shovels (because of insuperable barriers) is a physical impossibility. And we now again assert that a fair charge of all costs incident to the installation and operation of these machines, against the metal produced, would overbalance by more than $3,000,000 every dollar of assumed profit derived from the entire product of the mines from the commencement of operations to this date, and that this disparity of cost will continue and increase as long as this method is pursued.

Although we have frequently shown that the grade and quantity of ore available for extraction or known to exist in the property has at all times been grossly exaggerated and misrepresented by the trusted officers of the company in their reports to the stockholders and the public, we have consistently maintained that the property contains practically unlimited quantities of ore which—with intelligent methods—could be mined and treated at a very large profit; that, with the exception of the soil and stream gravel which occurs in depressions and flat portions of the surface, the so-called "capping," which has been removed to the extent of probably 15,000,000 tons would—if subjected to methods of crushing and concentration in use in any modern, first-class mill in Utah, Idaho, Montana or the Lake region—have yielded more profit per ton than is claimed to have been derived from the selected ores treated at the mills of the Utah company. And we have maintained, and challenge contradiction by any capable engineer, that all of the ores heretofore mined by steam shovel, and all so-called capping heretofore removed, and all known ores and capping remaining on the westerly side of the canyon stream, could have been, or can now be, mined and delivered into railroad cars at less than 10c. per ton by the very simple method known in miners' parlance as the "milling" or "gloryhole" system, such as is frequently applied to the extraction of iron ores in certain favored localities and as employed in modified form in the Treadwell mine, at Juneau, Alaska. In that instance, however, the rock is extremely hard and tough and costs are therefore comparatively high, yet infinitely lower than the cost which results from the operation of steam shovels upon the precipitous mountains of Bingham.

We have also characterized the construction of the Bingham & Garfield railroad as a reckless dissipation of the company's resources, absolutely unnecessary and indefensible from any view other than that it was expected to stimulate traffic in the shares held by the pooled interests. A few brief facts will demonstrate the correctness of our position: The assumed necessity for the construction of this road was predicated upon the pretense that the Rio Grande Western Railroad company had failed and was physically unable to transport the amount of ore required daily for the operation of their mills at their then existing capacity and that, therefore, that company could not possibly provide transportation for the increased tonnage of 16,000 to 20,000 tons which would be required to supply the mills when their capacity should be increased to that amount. At the same time we showed the fact to be that the R. G. W. Railroad company had frequently transported and delivered at the Utah company's mills more than 20,000 per day, and on certain occasions as much as 24,000 tons in one day, and that at all times, except in case of accidents or severe snow-storms, they had hauled all ore required as rapidly as the cars were filled and placed upon the receiving tracks.

During the progress of construction of the Garfield mill, when complaints against the railroad company were most persistent, we showed from actual figures that for a period of several months the railroad had actually delivered at the company's mills more than 1000 tons of ore a day IN EXCESS of the RATED CAPACITY of the completed portion of their mills—and nearly 2000 tons a day in excess of the amount claimed by the officers of the company as being treated at their mills.

But it was claimed that the rate charged per ton was high, and that a great saving would be made for the shareholder by transporting the ore themselves over their own road. This claim is wholly untenable, as we shall show: The contract with the R. G. W. R. R. Co. was for 6000 tons a day for a period of twenty years ending in 1926, and the rate for the first five years was 27½c. per ton, and thereafter 25c. per ton so that, from the close of this fiscal year, the rate will be only 25c. per ton.

A local official organ of the Utah company reports the estimated cost of transportation over the new Bingham & Garfield road at 17c. per ton. This compares with like cost of transportation by the Anaconda Mining Company, at Butte, over about the same distance but much easier grades and practically free from short curves. We predict, however, that costs on the Utah line will exceed 20c. per ton, owing to the many "switch-backs" and sharp curves to be encountered in getting down from the high mountain, where the ore will be loaded, to the main line, which itself is a succession of sharp curves and dangerous grades, as was forcibly suggested by the fact that one of the first trains consisting of some twenty odd R. G. W. cars jumped the track and as a result are now in the repair shops.

Assuming a cost of 17c. per ton over the new road, there would be an apparent gain of 8c. per ton as compared to the price paid the R. G. W. R. R. Co. A similar contract was entered into with the Boston Con. company about the same time for the same daily tonnage—6000 tons. This leaves only 8000 tons a day available to be handled by the new B. & G. R. R., provided the milling capacity be increased to the indicated amount. Working every day in the year the new road could haul only 2,920,000 tons of ore per year which, at 8c. per ton, would yield an apparent profit of $232,600. The cost of the Bingham & Garfield road is now conceded to be in excess of $5,000,000, of which amount $2,500,000 is represented by an issue of 6% interest-bearing bonds. The remaining sum cannot bear less interest. Therefore, $5,000,000 at 6% will produce an annual interest charge of $300,000, which sum exceeds the highest possible profit to be derived from the operation of the new road by $66,400. It has been erroneously claimed that the contract of the R. G. W. R. R. Co. with the Boston company is void and cannot be enforced. If this were true the new road would then have possible for transportation per year 5,110,000 tons of ore, upon which an apparent profit of 8c. per ton would yield $408,800 per annum, being $108,800 per annum in excess of the interest on the cost of its road. At this rate the investment would be returned IN A LITTLE MORE THAN FORTY-NINE YEARS providing, of course, that the supply of ore continued and that no time was lost; and also that the mills and the road should not wear out. But unless this "marvelous structure" should

Mines and Methods

Issued Monthly by the MINES AND METHODS PUBLISHING COMPANY, Offices 306 Tribune Building, Salt Lake City, Utah, U. S. A.

Address all communications and make all remittances to MINES AND METHODS

SUBSCRIPTION RATES

Single Copies 10c
By the Year $1.00
Applicable to United States Possessions, Cuba and Mexico

FOREIGN

Single Copies 15c
By the Year, Canada $1.50
Elsewhere $2.00

CONTENTS:

TWO KINDS OF WORKMEN

The Engineering and Mining Journal very pointedly observes: "There are two kinds of workmen. One works only to get in his time; the other works to do a good job and has joy in doing it. One drops his hammer at the first pull on the whistle cord: the other finishes driving the nail, and more, if necessary. One works to do somebody; the other to do something. The second kind of workman does not have to strike for increase in pay. That matter takes care of itself, and the man is apt to become a foreman and otherwise rise in the world. The other kind is fired when business is slack and then loafs around with a grievance."

Owing to delay in receiving copy through the mails, we have been compelled to hold Mr. W. L. Austin's article on "Leaching of Copper Ore" over till next month.

MONOPOLIES OF CAPITAL AND MONOPOLIES OF LABOR

By W. L. AUSTIN.

"The Standard Oil Company is no more. Its disoecta membra are scattered over a continent. Each of the thirty octopean tentacles is now a separate entity. The great central trust is 'busted' into thirty smaller trusts. There are thirty boards of directors instead of one board, and thirty presidents instead of one president. Each stockholder in the Standard Oil Company will have an equal number of shares in each of the thirty companies. The thirty companies will not be apt to compete with each other as at present constituted, for there is no instance on record of a man competing with himself. The question now arises, where does the public come in? Will coal oil or gasoline be any cheaper?

Where does the public come in? Well, for one thing there will be more men employed by the thirty separate trusts than found occupation under one gigantic corporation. More clerks, more artisans, and more laborers, for it will be necessary to keep up at least the semblance of conducting thirty separate businesses. More money will be distributed among the working class and less will go to those whose disregard for the laws of the land has enabled them to amass more than that to which they are rightfully entitled, for it has been decided by the Supreme Court of the United States that the Standard Oil Company was an unlawful combination. The prices of the articles manufactured and sold may not be reduced; but the profits that formerly went to the particular trusts which have been ordered to resolve themselves into their component parts, will be less, and much of the cash that found its way into the pockets of the few will now go into more general circulation, because it will not be practical for pre-existing "economies" to be exploited to the same extent as has been done.

It would be well, (now that a way has been found to de-organize monopolies), if the good work were carried forward until the power to work evil, of gigantic business combinations of whatever nature, corporate and incorporate, is given its quietus. If all the trusts in the country were compelled to disintegrate into the units out of which they were formed, it is manifest that many more opportunities would be available for those who are at the present time relegated to idleness on account of being deprived of their former occupations, through contractions (economies) enforced by the aforesaid trusts.

The railroads are complaining that business is light and that therefore retrenchment is necessary. Naturally, what else is to be expected? Men are being laid off at the iron mills and factories of all kinds: everywhere the ranks of the unemployed are being augmented, those of the workers decreased. As the number of spenders is reduced, the seriousness of the situation is aggravated. The American people are extravagant as a rule; but how can men spend money when they are not permitted to earn it? A mill-hand when thrown out of employment through stagnation in the iron trade, (due to lessened demand for the product of his handiwork because others who need it have not the means to pay for it, owing to similar stagnation in their particular lines of business for like reasons), cannot at once turn his hand to farming, nor can a miner start in growing cotton when the property with which he is connected closes down. Each individual has his trade, and when some huge combination is made, and economies are started which deprive him of ability to earn a livelihood at the occupation in which experience has made him proficient, he is usually placed in sore straits. The West to which, when undeveloped, any man could go and find something to do, no longer affords the same opportunities. Times have changed and enforced idleness exists there as elsewhere, for great combinations have stifled individual effort to a great extent there also.

One point appears to have been overlooked by those who advocate trusts, which is, that to make business, opportunity to earn a living must be extended to the mass of the people of a country, and not be confined to a select few: that the buying capacity of the many is at least as essential to general business prosperity, as is the ability to produce cheaply through combination and contraction. Artificially sustained monopolistic production, combined with exorbitant prices, is fatal to the prosperity of the country as a whole—when a large percentage of the spenders have to practice close economy. This patent fact is evident to such as possess the faculty of foreseeing coming events, and accounts in a great measure for declining values on the stock exchanges. Reducing expenses by throwing men out of employment is likely to be followed by reduction or suspension of dividends on the part of the great corporations, in order that they may be in a position to meet necessary operating expenses later.

We are told that the great combinations of capital, and those formed by a

These changes coincide with the opening of the 500-foot level of the mine. The ore shows itself there, whilst not yet free from signs of partial decomposition, contracted into a mass of sulphurets, which is a favorable indication of the continuity of the lode. As the stoping from the 500 to the 400-foot level has barely commenced and the "base" ore furnished to the mill during the last month came principally from the opening of the 500-foot level, it is obvious that for a time—that is, until a still lower level has been opened—the ore has shown its basest character, and a further deterioration need not be expected.

EXPERT'S FINDINGS.

The change in the proportion of silver which the base ore yields in the mill coincides, however, not only with a change in its character but also with a change in the working of the roasting furnace. The weekly chlorination tests made in December, 1877, show that the silver was converted into chloride to the extent of 80-70-77 per cent in the shaft, and 87-90-86 per cent in the flue of the roasting furnace, with correspondingly good results in the pans, as stated above. In April, 1878, they have dropped to 55-32-28 per cent in the shaft, and 81-77-63 in the flue, and the value of the tailings has risen in direct proportion therewith. Considering the low chlorination of the last months, the pan work was satisfactory enough, and proves that the roasting did good work in preparing the ore for the pan process, even if a less high chlorination was reached than formerly.

In studying up the reasons why the chlorination has dropped off, I commenced by separating and assaying the minerals which join in giving the ore its base character. I found the following minerals to be present in considerable proportion, and to contain, according to the assay of Mr. Gallagher, in silver per ton:

Iron Pyrites	$ 13.56
Zinc Blende	35.43
Antimonial Copper Ore	54.29
Galena	174.96

Of these four minerals I found that in the shaft of the Stetefeldt the iron pyrites is entirely decomposed; the zinc blende to a very large extent; the antimonial copper ore to at least one-half; the galena not at all.

The galena is easily distinguishable in nearly every piece of rock as well as in the roasted ore. This, coupled to the fact that the bullion contains no lead, and to the richness of the galena, shows where the increase in the value of the tailings comes from. From assays made by Mr. Watkis as to the percentage of lead in the ore, I deduct that about $10 per ton of tailings is carried away by the undecomposed galena. It is a matter of course that the difficult roasting of one mineral, of which there is at least 5 per cent in the ore, prevents also the complete roasting of other and perhaps richer minerals with which it may be mixed.

The question now arises how the decomposition of the galena may be effected.

The Stetefeldt roasting furnace has many advantages. It works cheaply in fuel and labor and surpasses all others in capacity and durability. But its greatest virtue is at the same time its disadvantage—I mean its unalterableness. A bad management cannot spoil, a good one cannot improve it. As long as the feeding machinery is kept in order, the fire maintained and the ore properly withdrawn, the most shining metallurgical star and the darkest ignoramus are about on the same level. Still, although I consider a change in working the Stetefeldt furnace, as it stands, a difficult and risky task, I think in building a new furnace an improvement might be advisable. It consists in this: To dispense with the present method of drawing the red-hot ore into a cart and dumping it on the cooling floor, but to allow it to fall directly from the furnace on a covered hearth, say 30 ft. long, 8 ft. wide, 2 ft. high, pitching under an angle of about thirty degrees to the cooling floor. As it is now, the ore is withdrawn from the furnace in the very midst of the roasting process, steaming off copiously sulphurous gas, to the great annoyance of the furnace-men. By the improvement which I suggest the ore gets a chance to finish, as it is kept on the inclined hearth red-hot with free access of air for one or two hours. I cannot see any increase of costs for fuel or labor in the new arrangement, and the natural slope of the hill on which the new furnace would be erected favors it. If it works well at the new furnace it may easily be adapted to the old one.

If the ore is allowed only time enough, there is no trouble in bringing the ore to the proper state of chlorination. The same "battery-samples" which on the large scale were chloridized only 30 or 40 per cent, yielded in the muffle of the assay furnace in three experiments respectively 66-74-80 per cent to the chlorination test, and by increasing the proportion of salt I got 90 and 85 per cent.

In connection with a new furnace, I propose another change. I refer to the drying-kiln. The present arrangement is not only very expensive in its first construction, but also costly to work and a dangerous nuisance to the men, who have to be induced by high wages and short hours to work there. Not to mention the disagreeable necessity for the men to walk on hot plates all day long, there is much danger to their health from the arsenic which the ore contains, and which begins to roast off at a very low temperature. The garlic-like smell of arsenious acid is occasionally quite noticeable and may give rise to bad accidents any day. Besides, the cleaning of the labyrinth of flues underneath necessitates a stoppage of the whole mill for a week or more every three or four months. The view of saving the fine ore-dust has been here carried out too far. From the flues under the drying-kiln there are gathered about 50 tons every three and one-half months, assaying considerably under the average ore, and representing for about 3,000 tons roasted during that period barely 1 per cent in value.

IMPROVEMENT SUGGESTED.

The improvement which I propose is: To conduct the waste heat from the roasting furnace to the chimney, which this time ought to be placed higher up on the hill, through an ascending flue, covered with iron plates about 8 feet wide. This flue will connect the ore-chute directly with the battery-hopper. Thus the wet ore will move gradually to the hottest place, can be discharged to the hopper as soon as finished, and the man may work the kiln from the outside. There is only one place—at the bottom of the incline, where the hot gas enters—that might possibly get overheated, and here a wooden hood and chimney could be placed to carry the deleterious gas through the roof. As the flue can easily be reached from the outside for its whole length, there need be no stoppage of the mill in order to clean it.

With regard to the loss in tailings—still referring only to the "base ore"—I found that the loss is currently overestimated. It has been assumed that one ton of ore gives one ton of tailings. This is not so. By repeated experiments I determined the following facts:

(1) The dry ore, as it comes from the battery to the furnace charged with 15 per cent salt, loses in the furnace 17 per cent in weight by volatilization. I do not refer here to the loss in flue-dust.

(2) The roasted ore loses 3 per cent more in the pan by the dissolving action of water.

In summer, the loss is 25 per cent in weight, that is four tons of "battery-ore" yield only three tons of tailings.

silver into metallic silver, and be itself dissolved instead. The result will be a spongy mass of fine silver, which is washed, dried, and melted, and a solution of sulphate of copper, which, when brought to crystallization, will yield crystals of the commercial blue-stone. The blue-stone, thus obtained, will be of a superior quality, as there is no method in existence by which a purer article can be manufactured. A roasting of the retorted bullion (that is, keeping it red hot, with access of air, for some hours) will facilitate the operations, and save acid, but it is not necessary. There is no silver lost in this process, nor any other by-product but blue-stone obtained.

The two questions which I had to settle by actual experiments were: (1) Will the retorted bullion dissolve in strong sulphuric acid, and (2) is it in the shape as it comes from the retort porous enough to allow the other reaction?

In experimenting on pieces of retorted bullion, between 700 and 800 fine, of the size of a walnut in the laboratory, I easily and repeatedly obtained a silver-residue which, after melting, showed a fineness of 991.

I then operated on large pieces as they actually came from the retort assaying 800, and obtained from 21 pounds a bar assaying 940.

For a second experiment I roasted 50 pounds bullion from the base side, assaying 611, and extracted the oxydized copper by dilute sulphuric acid (metallic copper requires strong, oxydized copper only weak acid) melted one half of the residue down and obtained a bar 835 fine. This showed me how far the copper could be removed by roasting alone, to-wit:

In bullion 611 fine are mixed. 611 lb silver with	389 lb. copper
In bullion 835 fine are mixed. 611 lb silver with	121 lb copper
Removed by acid after roasting	268 lb copper

That is more than two-thirds of the copper.

Of the bullion of the original fineness of 611, of which one-half had yielded the bar of 835, the other half was "finished" in the manner described above, that is, a portion of it was dissolved in strong acid in an iron kettle and boiled in a lead-lined tub with water and the other portion. The result was a bar. The assay was not finished when I left, but from the appearance I think it will be high enough.

As I made the three bars under favorable circumstances and from pieces as they are actually obtained on the large scale, these three experiments were sufficiently convincing for myself. The test of considerations, the plant required and the method of working are perfectly familiar to me, not differing essentially from the usual refining operations.

Taking as a basis the product of March, 1878, I find that the Ontario mill shipped:

166,332 oz. bullion with 135,100 oz. silver and 31,232 oz. copper.

Equal to 11,392 lb avoirdupois with 9,253 lb. silver and 2,139 lb. copper.

Or per day 379 lb bullion with 308 lb. silver and 71 lb. copper.

This represents an average fineness per month of 812. Now, it will be necessary, if working the above process.

(1.) Without roasting: To dissolve in strong acid 40 per cent of 379 lb. bullion with 123 lb. silver and 28 lb. copper, and to precipitate the silver by 60 per cent of 379 lb. bullion with 185 lb. silver and 43 lb. copper—100 per cent—379 lb. bullion with 308 lb. silver and 71 lb. copper.

The 123 lb. of dissolved silver will be precipitated by 43 lb. metallic copper.

Acid Required:

To dissolve 123 lb. silver,	123	lb. com l con acid
" " 28 " copper,	93	" " " "
	216	" " " "
Add 25 per cent for loss	54	" " " "
	270	lb. of acid.

The yield in blue-stone will be 4 pounds for each pound copper—4x71—284 lb.

Expenses per Month:

1.	Wages, 1 man at $150	$150 00
2.	½ cord wood per day = 15 cords at $4	60 00
3.	½ ton coal in steam-boilers = 15 tons at $9	135 00
4.	30 barrels for blue-stone at $1 25	37 50
5.	Sundries	100 00
6.	30x270 = 8,100 lb. sulphuric acid at 2¾ cts in S F	222 75
7.	Freight on Acid: 8,100 lb. Acid. 1,350 lb Packages = 1-6 of 8,100; 1,350 lb Packages to go back empty; 10,800 lb. at 5 cents	540 00
		$1,245 25
	Income: 30 x 284 = 8,250 lb. blue-stone at 11 cents	937 20
	Net Expenses	$ 308 05

(2.) With roasting:

To refine per day as above, 379 lb. bullion with 308 lb silver and 71 lb copper.

Converted into Oxide by roasting, 35½ lb bullion with 308 lb silver and 35½ lb. copper.

Remains for "finishing", 343½ lb bullion with 308 lb silver and 35½ lb copper

To dissolve in strong acid 30 per cent, 103 lb bullion with 92½ lb silver and 10½ lb. copper

And to precipitate the silver by 70 per cent, 240½ lb. bullion with 215½ lb silver and 25 lb copper.

The 92½ lbs. of dissolved silver will be precipitated by 25 lbs. metallic copper.

Acid Required:

To disol 35½ lb. cop. as oxide,	59	lb of con acid.
" 10½ " " " metal,	35	" " "
" 92½ " " " silver,	92½	" " "
	186½ lb.	
Add 25% of 35x92½ = 127½ lb =	31½ lb.	
	218 lb	of sul acid.

The yield of blue stone is as above—284 lb. per day.

Expenses per Month:

1, 2, 3, 4, 5, as above	$ 482 50
6. 30x218 = 6,540 lb Acid at 2¾ cts. in S. F.	179 85
7. Freight on Acid: 6,540 lb. Acid; 1,090 lb. Packages = 1-6 of 6,540; 1,090 lb. Packages to go back empty; 8,720 lb. at 5 cents	436 00
	1,098 35
Income, 8,520 lb. blue-stone as above at 11 cents	937 20
Net Expenses	$ 161 15

If a refining room is built at the mill, it should be constructed, however, with a view, that the "free ore" bullion will soon be replaced by "base ore" bullion. Assuming the same returns in silver as in March, 1878, and the fineness of all the bullion at 611, as the "base ore" bullion runs now, the account will stand:

Produced per month, 15,144 lb. bullion with 9,253 lb. silver and 5,891 lb. copper.

To refine per day, 505 lb bullion with 308 lb silver and 197 lb. copper.

Converted into oxide (as per exper.), two-thirds of the copper = 131 lb copper

Remains for "finishing," 374 lb. bullion with 308 lbs silver and 66 lb. copper.

To dissolve in strong acid 40 per cent = 150 lb. bullion, with 123 lb. silver and 27 lb copper.

And to precipitate the silver by 60 per cent = 224 lb. bullion with 185 lb. silver and 39 lb copper.

The 123 lbs. of dissolved silver will be precipitated by 30 lbs. metallic copper.

Acid Required:

To disol. 131 lb. copper as oxide,	218 lb	sul. acid.
" 27 lb. " metal,	90 lb.	" "
" 123 lb. silver,	123 lb.	" "
	431 lb.	sul. acid.
Add 25% of 90+123 = 213 lb. as loss	53 lb.	" "
	484 lb.	sul. acid.

The yield in blue stone will be 4x197—788 lbs. per day.

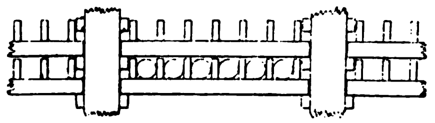
Expenses per Month:

2 men at $150 and $120	$ 270 00
1 cord wood per day = 30 cords at $4	120 00
15 tons coal at $9 in steam-boilers	135 00
80 barrels for blue stone at $1 25	100 00
Sundries	100 00
30x484 = 14,520 lb. acid at 2¾ c. in S. F.	422 40
Freight on Acid, 14,520 lb Acid; 2,420 lb. Packages = 1-6 of 14,520; 2,420 lb. Packages to go back; 19,360 lb at 5 cents	960 00
	$2,116 40
Income: 30x788 = 23,640 lb. blue-stone at 11 cents	2,600 40
Net Profit	$ 484 00

It appears, therefrom, that the lower the bullion the higher is the yield in blue stone. Mr. Chambers anticipates no difficulty in selling a car-load or two a month to the mills in Utah or the northern territories. In case of need, Virginia City will take all.

The main point, which will decide on the rentability of the process, is the freight on sulphuric acid. I have to leave it to yourself to see what arrangements can be made either at the Central or the Union Pacific railroads' headquarters. I figured up 5 cents per pound. Deducting 1 cent for freight from Ogden to the mill, there would be left 4 cents per lb., or $800 per carload of ten tons for the distance, San Francisco to Ogden or Omaha to Ogden. The freight

Consolidated Mining Co., appeals to me. In both cases they have rigged up a sort of cabinet, using the core boxes without lids as drawers. The boxes slide lengthways into a rack or cabinet. The boxes or trays are stacked so close together that the bottom immediately above acts as its cover. At the Victoria, a strip the full length of the box is nailed on either side, forming the slides for the drawer. A drawer-pull and a label giving the number of the hole and the depths of the hole from which the core was taken is fastened to one end of the box. At the Mass they have overcome the necessity of nailing strips to the sides of the box by allowing the bottom of each box to extend about half an inch on either side. The boxes are made about 5 ft. long, which is a convenient length to handle, and holds enough core for ordinary purposes. The cabinet itself is made very similar to any ordinary cabinet, holding drawers, except that it is not necessary to put a piece of wood under each drawer as a stiffener. If the sides are made of 2-in. material, a stiffener need only be introduced about every 10 boxes. Sides or partitions are made for each stack of core boxes and as high as desired. These had better be made pretty heavy, as they must support the entire weight of all the boxes in each stack, and in order to make the construction as slow burning as possible, I would suggest a tight partition. Strips are nailed on both sides of these partitions to catch the strips on the boxes, thus supporting them. These strips should be placed just far enough apart to allow easy and free sliding of the boxes.



The accompanying sketch will explain the construction fully. The advantages of this system are the convenience in referring to the cores at any time and small amount of space required. Each box occupies a space of 10⅞x2 3-16 ins. Allowing one stiffener for every 10 boxes, 30 boxes can be stored in a stack 5 ft. 9 ins. high. As each box holds 30 ft. of 1⅛-in. core, which represents approximately 40 ft. of drilling, one stack would represent 1,200 ft. of drilling. Ten such stacks, representing 12,000 ft. of drilling, would only occupy a space 6 ft. high, 10½ ft. long and 5 ft. deep. I do not believe that the same number of boxes with covers screwed on could be gotten into the same space, and I question if the lumber and screws used for a cover would cost as little as would this scheme. The only objection to the scheme is the trouble involved in transporting the boxes from the drill. The Mass Mining Co. solved this by making boxes with hinged covers and locks which would just hold one core box. The core box was then placed in the box, which was then locked and sent to the mine office. For shipping, the core boxes could be crated readily enough.

I wonder, with such a convenient method as this of storing cores, if as much core would be thrown away as is now done. After so much money has been spent in obtaining the records it seems too bad to see the true records destroyed. I often encounter the argument "Of what good are they?" They usually are no longer of any use to you, but someone else may examine them and see something of great scientific or practical value. There is some excuse for a person holding merely an opinion on a piece of land to throw away the cores, as he may not have any place to store them but in those cases I truly believe that the Geological Survey should make an attempt to preserve the records.

CONSERVATION SHAM

The much used term "conservation" has come to mean, in the minds of politicians, the prevention of private ownership of anything that has thus far escaped this destiny, says Mining Science, of Denver. In their moments of professed frankness, such "conservationists" intimate a desire to prevent the monopoly of the resources of Alaska and other western regions. But the fact is that the proposals cited are clearly in aid of "monopoly." Only highly concentrated capital will be able to reap benefit from the restrictions that the government is asked to impose upon Alaskan development, for it alone will be able to meet the conditions.

MYSTERIOUS SALT SPRINGS

Geologists have as yet given no satisfactory explanation of the origin and occurrence of the very interesting salt springs (sodium chloride) at Salinas, San Luis Potosi, Mexico, about fifty-five miles northwest of the capital, says Mining Science of Denver. In the rock formation of the vicinity there is no indication of salt deposits and there is no evidence of the local origin of the saline waters. The springs are at an elevation of about 7,600 feet above sea level in a small basin of sand and calcareous matter. The surrounding hills are of cretaceous limestone and the basin is evidently an old lake bottom. All sub-surface water for many miles around is highly salty. The subterranean salt stream is charged with 1⅛ to 2 per cent of salt, but the ground is thoroughly saturated and adds to the salinity of the water of the springs. It is thought that the stream comes from the north, possibly as far a Chihuahua under some pressure. The springs discharge from a depth not exceeding twenty feet into a shallow lagoon, the spring region comprising some 600 acres. The lagoon is never more than ten inches deep and at times entirely dry with a surface crust of saline matter.

A TOAST TO LABOR

Here's a toast to every man,
Of every race, and creed and clan,
Who
By his manhood strong and free,
Digs from the earth, wrests from the sea,
Their treasures,
And whose arm and mind,
Leaves to his fellows—all mankind,
His heritage—his work.

So, here's to the man who digs the gold,
And here's to the man who makes the mould,
And here's to the man who mints the rim,
And here's to the man—good luck to him,
Who
By his strength of arm and mind,
Leaves to his fellows—all mankind,
His heritage—his work.

Here's a toast to the woman, too,
Man's comrade staunch, man's comrade true
Who
By her womanhood soft and sweet,
Coaxed into light from its dark retreat,
Man's treasures,
That his arm and mind
Might leave his fellows—all mankind,
His heritage—his work.
So, here's to the man who digs the gold
Who fashions its shape into wealth untold,
With water or wine—filled to the brim
We'll drink this toast—good luck to him
Who
By his strength of arm and mind,
Leaves to his fellows—all mankind,
His heritage—his work.

—HARRY IRVING GREENE.
In Houghton (Mich.) Mining Gazette.

Graphite can be distinguished from molybdenite, which it closely resembles, by the slightly greenish tinge of the streak of the latter and its sulphur reaction, when fused with soda before the blowpipe.

the "waste" all over the country round about, just as though it was valueless.

****

Mount Aetna is throwing out more lava in a week than it did in a month during its former eruptions. Maybe it has caught up with the times and is using steam shovels.—Chicago Daily News, Sept. 19.

****

It is evident, from the news contained in the above item, that the Chicago News has heard of Utah Copper, which is probably the only real rival that Aetna has.

****

To the engineer of imagination the scene at Bingham at night, with the shovels at work beneath the glare of the searchlights placed upon the hills opposite is dramatic in the extreme; indeed, the whole work which D. C. Jackling and his associates have carried on is a striking example of creative imagination applied to engineering work.—Salt Lake Daily Tribune.

****

CURTAILING PRODUCTION. — The Utah Copper Company, having completed Janney-izing six of the thirteen sections of its Arthur mill, and having run short of available cash, without encroaching upon the dividend fund, and at the same time being unable to secure the quantity of ore necessary to supply further increased milling capacity because of the lack of sufficient number of steam shovels to keep the capping removed in advance of the ore shovelers, discharged about 450 men and suspended indefinitely all work of construction on the remaining sections of that plant, thereby evidencing their proverbial good faith in observing last year's "gentlemen's agreement" to curtail production.

****

In the last Babson financial letter very favorable treatment is received at the hands of this prominent statistician by the Utah Copper and the Utah Consolidated companies of Bingham; also the Chino Copper company of New Mexico. Babson believes that these coppers are among the list mentioned that are deserving of consideration from an investment standpoint, and he believes that the time is here to lay in some of these copper issues, but according only to the Babson method. This method contemplates the purchase of twenty or thirty stocks instead of one or two.—Salt Lake Tribune, Sept. 1.

****

Some time ago Mines and Methods expressed the opinion that Babson had become attached to the Utah Copper's publicity staff and the foregoing reference to his work at least tends to strengthen that opinion. But, if Utah Copper and the other stocks mentioned are such good buys at prevailing prices, why should Mr. Babson advise the purchase of twenty or thirty other stocks at the same time? Does Babson also feel insecure in his evidently purchased expressions concerning "the world's greatest copper mine"?

****

ADVANCED ENGINEERING THOUGHT—As early as 1908 Manager D. C. Jackling, in his annual report to the president of the Utah Copper Company—in his customary quiet and unassuming manner—gave utterance to the following brilliant thought: "There are some advantages in continuing underground mining in some portions of the property, because the ore mined in this way is taken from the orebodies lying directly beneath the capping, resulting in the capping caving into the open stopes and BREAKING ITSELF, so that it is not necessary to blast it for steam shoveling." Salt Lake Evening Telegram and Walker's Weekly Copper Letter will please copy and send bill to us.

****

MIAMI.—The fine grinding in one-half of the fourth section is being done with an 8-foot Hardinge pebble mill instead of Chilean mills used in the first three sections. One Hardinge mill has been found capable of doing the same amount of work as a Chilean mill. The other two and one-half sections probably will be equipped with Hardinge mills.—Boston News Bureau.

****

From Walker's Weekly Copper Letter, (Copyright, 1911, by Dukelow & Walker Co.): "When there comes to be a full public appreciation of the immense demonstrated value and earning capacity of the Utah Copper company its stock will be sought as an investment at prices ranging between $75 and $100 a share. At its present price it is one of the safest investments and surest speculations in the mining world.—Geo. L. Walker."

****

The tenth annual edition of the Copper Handbook by Horace J. Stevens, of Houghton, Mich., is now being issued from the press. Eighteen months have been spent in an absolutely complete revision of the mine descriptions and statistical section of the book. The new edition, Vol. X, contains 1902 octavo pages of text, and lists and describes 8,130 mining companies, mines and so-called "mines," this being much the largest number of titles given in any work of reference on mines. As in preceding years, there are several hundred pages of preliminary chapters, devoted to the history, technology and uses of copper.

****

The appearance of Mr. Stevens' latest volume will cause much speculation in copper mining circles. The boys will all want to see the book to learn just what sort of a "rating" or "berating" Mr. Stevens gives them.

****

From an inside authority comes some interesting, though belated, information concerning the plans for a giant copper merger. This information is positive that the project is definitely shaped, but held up indefinitely. The plans for the merger, along the Steel Corporation lines, were perfected in New York some time before the Supreme Court decided the Standard Oil and Tobacco Trust cases. The full details and the papers in the merger were carried to Washington and submitted to Attorney General Wickersham and others in authority there, and were fully approved by the attorney general, but, on advice, the promoters withheld final action on the merger until the Supreme Court decided the Trust cases. When the decisions were handed down there was such a cry from the press, or one class of them, and from the public, that it was deemed unwise to spring another gigantic trust upon the public at that time. Washington advised against it, and suggested that the announcement be deferred until a more propitious time. Later politics came in, and Republican leaders prevailed on the copper men to hold off their merger until after the next Presidential election. And that, it is claimed, is the present status of the big copper merger.—Butte correspondent in London Mining Journal, August 28.

****

Great preparations are evidently being made to work the English investors when the time is ripe. It is a "lost hope" of saddling off on to someone the big things in copper which are too good to keep.

Returns to the Ontario Bureau of Mines for the first six months of the current year are more than usually gratifying. Whilst the production of copper and nickel has fallen off, the output of silver is greater by 2,417,142 ounces than it was during the corresponding period last year. The amount of iron ore mined is 94,803 tons, or 55,306 tons in excess of the quantity mined during the former half of 1910. Gold once more appears on the list, 2,276 ounces having been extracted up to June 30th, 1911.—Canadian Mining Journal.

Mines and Methods

Vol. 3; No. 2 — SALT LAKE CITY, UTAH, OCTOBER, 1911 — Every Month

Mines and Methods

Issued Monthly by the MINES AND METHODS PUBLISHING COMPANY, Offices 306 Tribune Building, Salt Lake City, Utah, U. S. A.

Address all communications and make all remittances to MINES AND METHODS

SUBSCRIPTION RATES

Single Copies	10c
By the Year	$1.00

Applicable to United States Possessions, Cuba and Mexico

FOREIGN

Single Copies	15c
By the Year, Canada	$1.50
Elsewhere	$2.00

CONTENTS:

Iron rails make better sluice riffles than any other material and are laid lengthwise on a 4 by 6 scantling. The gold settles admirably in the space between them.

Carbon monoxide, CO, is a product of the incomplete combustion of fuels containing carbon. It is very poisonous, small quantities when breathed producing death.

The application of the barometer for measuring altitudes depends upon the fact that the atmospheric pressure decreases as the altitude increases.

PRACTICAL HINTS ON ORE DRESSING

The somewhat recent development of fields of low-grade copper ores has greatly enlarged the demand for that class of ore-concentrating devices theretofore in use in the treatment of the finely divided portions of the mineral contents of ores of all classes which from times almost immemorial have been subjected to some form of hydrous concentration. And whilst these new developments have, either by accident, good fortune or otherwise, caused to appear upon the horizon of the so-called technical world, many aspirants for primigenial honors the appearance of the new ores was not attended with any new or vexing metallurgical or mechanical problems except alone such as naturally arise from a rapid increase of a very familiar commodity, which in this case has imposed no serious burdens upon our splendidly equipped machinery manufacturers.

The copper mineral contents of these ores occurs, almost exclusively, in small sharply-defined grains disseminated throughout an exceedingly soft and friable gangue-stone, or in thin hard plates and films occupying fracture-planes therein, and readily yields to slight pressure from any form of crushing device capable of reducing the mass to about thirty-mesh, standard wire screen, from which it will be seen that the entire product becomes of that class which is amenable to successful concentration only by some form of bumping or jerking table, or by the buddle, or some type of traveling belt, long in common use. Of course, in the preparation of any ore for concentration, whether a portion of the constituent mineral be massive, and susceptable of recovery in coarse particles by means of jigs, as in case of the older mines, or whether the entire mass as in case of these new ores, must be reduced to a consistency adapted to treatment only by tables or buddles, it is of the utmost importance that the crushing be done in such manner as to avoid as far as practicable the abrasion or destruction of the chrystaline or granular form of the mineral particles.

Owing to the comparative softness, friability and law of specific gravity of the rock-gangue of the new ores, recovery of the mineral contents presents far less difficulties than does the correspondingly fine pulp which results from reduction of the more massive sulphide ores of the older mines. So that, in selecting concentrating as well as crushing machinery for equipment of the new mines, it was only necessary to ascertain what type of machines were employed in any one of the standard concentrating mills in Montana, Idaho, Arizona, or in fact any locality where successful concentration was being conducted. No one need to have made a mistake in this respect because—if we except the Wilfley and kindred tables and certain unimportant modifications of the old Frue vanner—practically no important or material change or improvement had been made in crushing or concentrating machinery for thirty years.

Therefore, in view of these facts, the silly slush which from day to day has burdened a certain class of truckling publications during the last five or six years—whereby extraordinary genius, skill and foresight has been attributed to every act and movement of those individuals who have had the good fortune to become attached in a managerial or even subordinate capacity to any of these new enterprises—is but nauseous drivel. It is true, however, that these obsequious parasites, whilst acting as the paid servants of unscrupulous market fakirs have, by persistent subtle flattery so inflated the pliant egotism of the executive heads of some of these new enterprises as to render intelligent progress upon established lines impossible. They have been unconsciously placed upon a pedestal of scientific intuition which comprehends all essential knowledge of the art of ore dressing without having been subjected to the humiliation of having to inquire how others before them had proceeded in similar undertakings. What wonder, then, that millions of dollars should have been swallowed up in the construction of mills totally unadapted to the purpose designed, and that, immediately upon the completion

of each of these costly structures, the work of replacement and reconstruction should follow with such close step as to tread upon the heels of the workmen who had laid the foundations of the original structure. Usually the original machine was superceded by another less fitted for the duty required, but occasionally a step was unconsciously made in the direction of established practice. But just why one kind of a machine should produce better results than another in the stubborn process of ore concentration will probably NEVER BE KNOWN TO EVERYBODY and need not be discussed here. But there are certain elementary principles and fixed laws which prevail in any successful process of ore concentration which it would be well that every mechanical engineer should understand who undertakes to design or construct an ore concentrating mill. However, such knowledge is not so essential if the engineer has the sagacity and courage to restrain his pride and adopt the design of a first-class plant which is in successful operation. With a mill so constructed it is only necessary to employ a crew of men who have been seasoned in the practical work of operating similar machinery in a similar mill, care being taken to secure an intelligent foreman of experience in the work. Never employ a NEAR RELATIVE OR CHUM as superintendent of concentration because, in the first place, they will never learn the business and think they don't have to; and then you can't discharge them because they always have "something on you."

With appliances and methods which for many years have been in successful use in the older mines—as before indicated—the concentration of these new ores becomes at once extremely simple and a comparatively high recovery of the copper contents should be easily attained. And yet, owing to lack of experience and elementary knowledge of the basic principles upon which successful results depend, the operators in case of all of these new enterprises—with the possible exception of the Miami—have fallen far below results attained in the treatment of similar ores of the old-fashioned mines.

In the near future Mines and Methods will discuss the theory and principles of scientific and practical ore concentration, in which we shall take the position that screen sizing, as employed in general practice, is carried to harmful extent, and that water classification in any form is absolutely destructive of best economic results.

TRUTH IS FINALLY OUT

It will be recalled that a deal was consumated two months ago by which the American Smelting & Refining Company took over the smelter proposition under contract to build. There has been marked activity at Hayden ever since the A. S. & R. acquired the smelter concession. The site that had been laid out by the Ray Consolidated and partially graded, was slightly changed and men and teams and steam shovel are now being worked night and day excavating for the new site on the north side of the gulch, near the Ray Con. power house. Surrounding the works has risen a tent city within the past few weeks where the workmen are housed. Commodious office quarters have been opened up, the entire second hoor of the McIntyre store building being used. There are 200 teams, a steam shovel and near 300 men employed. —Arizona (Hayden) Copper Camp, Oct. 11. 1911.

Of course the publisher of the little paper at Hayden did not dream, when he published the above item of news, that he was the first to tell the truth about the progress that had been made in the building of the Ray Consolidated smelter. For many months last year and early in the present year the "market builders" for the Utah Copper, Ray and Chino companies, were working overtime telling of the big things that were doing in Ray Con. smelter construction. Finally they had to "back up," as the money was not forthcoming to build the plant. They squeezed out by announcing that the Guggenheims would take over the "partially completed smelter" and would "PAY BACK ALL THE MONEY THE RAY HAD INVESTED IN ITS CONSTRUCTION AND EQUIPMEN TO DATE."

Like everybody else, we had imbibed the impression that the Ray Consolidated had really undertaken the building of a smelter—and we even thought it must be well under way when its sale to the Guggenheims was made, something over two months ago. But, as disclosed in the item from the Ray paper, we were fooled again—and so has been the public. The smelter had not even been started and only a small amount of grading for the site had been done. The Guggenheim engineers at once decided to go on the opposite side of the gulch to prepare ground for the contemplated plant, and thus they helped to clinch Si. Eccle's declaration that D. C. Jackling is "one of the greatest and most competent engineers in this or any other country," for there is no doubt that Mr. Jackling as manager of the Ray Con., selected the original site for the new smelter.

———o———

"BEFORE AND AFTER"

The Utah Copper property was purchased about six years ago on a tonnage basis of 10,000,000 tons actually developed and 10,000,000 tons of probable ore, averaging about 2% copper, and the stock sold at 24 on this tonnage basis.

Today the company has 203,000,000 tons of reserves, the $7,000,000 cost of plants and equipment has already been paid back in dividends in three years, and with a present production rate of over 100,000,000 lb. copper per annum, and dividends of over $4,500,000 a year, the stock sells around 40.

Could anything be more dishonestly misleading than the paragraphs quoted above? They are taken from the News Letter, published by Thompson, Towle & Co., October 11. In the first place when Utah Copper was selling at $24 00, as stated, the company's capitalization was only 450,000 shares, and its indebtedness was insignificant by comparison. Today, with the stock selling around $41, there are 2,500,000 shares to conjur with —quite a difference when you come to think about it. At $24 the market value of the company's holdings was $10,800,000; at $41, the market value is $100,250,000. Had the capitalization remained at 450,000 shares the money now being disbursed as dividends would have yielded more than $12 per share per annum, instead of $3. This conclusion of course is based on the supposition that the company would have continued to maintain its widely-heralded position of a "self-contained manufacturing proposition" and have kept within reasonable bounds in the matter of financing.

But there is where one feature of the company's campaign of deception crops out. At the time its management was most glib in recital of the "self-contained manufacturing proposition" idea it was practically at the end of its rope, so far as steam shovel operations were concerned, and this magazine called attention to the fact that inside of three years, unless the company secured additional ground, it would necessarily have to cease operations—through the plan inaugurated—for lack of available ore. Inside of six months—not three years—the company proceeded to show the falsity of the declarations it had made by opening negotiations for the purchase of Boston Consolidated and soon thereafter the deal was closed. That transaction substantiated our claim and left the management in an equivocal position insofar as its being able to convince the investing public of its honesty of purpose was concerned.

About the same time this magazine took up other features of the company's campaign of deception. It showed with what utter recklessness of cost, lack of care and disregard of established practice in the construction, equipment and methods applied to recover the copper from its low-grade ores, the company was proceeding. And every claim and charge along these lines that has been made has been verified times without number by facts and figures that the company has never disputed or challenged.

But we have told all these things so many times, and we have more recently so clearly shown into what financial straits the company has drifted, that it is hard to believe that the investing—or even the speculative—world will be led into the trap that has been baited for them by the hired press and brokerage representatives of the pooled interests crowd that is only waiting the chance to let the public "hold the sack" while they "cash in;" because, to assume for a monment that representations heretofore and now being made in respect to the value of this property, are true, is to assume that the owners and managers of this professedly-great mine are a band of lunatics, seeking to dispose of tremendously valuable assets at a mere tithe of their worth.

---o---

THE ABSURDITY OF IT

The Salt Lake Eevening Telegram tries awfully hard to keep saying things that will please the Utah Copper and other "new porphyries" managers. In its anxiety to prove its loyalty "to the cause," it frequently makes a spectacle of itself. On the 12th of the present month it had two articles—original or pilfered—in the same column from which the following brief quotations are made:

Sherwood Aldrich, president of the Ray Consolidated Copper Company, is scheduled to reach here about October 23, and in company with General Manager D. C. Jackling he will make a trip to the company's properties in Arizona.

A supporting factor in the copper metal market situation has come to light since the first of the month. The supposition has been that with the new porphyries coming in there would be a greatly increased supply of the metal, and contrary to this_view it has been demonstrated that it will be some time before these new properties reach the point where they will become an important factor in the metal production of the world.

Ray's new mill is easily handling all the mine product at this time, and the management is very much pleased with results obtained, which is now showing a considerable profit on operations.

This gives some idea of the ultimate capacity of the mill plant, as the four sections now in operations are treat... close to an average of 900 tons daily.

At times a high grade run will be put through, and naturally a large percentage of recoveries will be shown in the concentrates.

Within less than a year it seems highly probable that the directors of this company will be considering the proposition of paying dividends.

The three more important mines which are figured on increasing the supply of copper metal are Ray, Miami and Chino. Miami is not expected to produce more than two-thirds of its ultimate output; Ray may not make more than three-eighths of its capacity and Chino is just getting its new plant into commission and will hardly output more than one-third of its capacity for some time.

While these mines have been expected to reach a minimum output of 170,000,000 pounds of copper during 1912, it seems now probable that they will fall far short of that quantity.

And as Brother Higgins, of the Salt Lake Mining Review, would say: "And there you are; and then some."

WALKER MAKES DENIAL

To the Editor of Mines and Methods,
Salt Lake City, Utah.

Sir: In the September issue of Mines and Methods I find the following statement:

"When we come to consider that Mr. Walker's writings during the last few years have enabled him to accumulate several millions of dollars, one can form some idea of the value or cost of the foregoing to the Utah company; but perhaps a more correct conclusion in respect thereto may be found from the following, which is related by a newspaper man of this city: 'It appears that during Mr. Walker's last annual swing around the circle of Western contributing mines he prepared and published a highly complimentary description of the property of the Mason Valley Copper company's mines at Yerington, Nevada. This happened at a time when that company was offering for sale an issue of bonds for the purpose of securing funds with which to equip their property with a smelter. In recognition of the aid rendered by Mr. Walker, it was said that the company promptly sent him a check for $1,500, which he as promptly returned with the remark that the write-up was worth to the Mason Valley Company $5,000. Whether that amount was paid or not our informant was not advised, but we note that Mr. Walker's report on Mason Valley for this year is even more favorable than the last, and therefore it may be inferred the estimated value of the precious send-off was paid.'"

There is not one iota of truth in your statement. If you will prove that I was either offered or accepted $1,500 or $5,000, or received and accepted or refused a check for any other amount, I will give $5,000 to any Salt Lake City charity you may select.

You will confer a favor if you will publish this letter in your forthcoming issue. GEO. L. WALKER.

Boston, Mass., October 20, 1911.

---o---

THE COPPER SITUATION

The New York correspondent of the Mining and Scientific Press (Oct. 21) comments entertainingly—and with evident understanding—on the copper situation as follows.

"Copper producers in general appear to be tightening belts and preparing for a further indefinite period of low prices and decreased consumption. Unsettled conditions abroad must cut down the real export demand, and, while it is said on all sides that stockyards are as bare as they can be so long as business continues at all, yet there is no incentive, either in general business conditions or in the copper situation itself, to induce consumers to take on copper. * * *

"Some of the market developments of the week have been aptly illustrative of the absence of public interest. Tuolumne failed to declare its regular quarterly dividend since which announcement the shares have been advanced and the market held apparently strong, mostly because there was no attempt by the public to make market capital out of the cessation of dividends. Another instance was the advance in Chino and in Ray Consolidated immediately upon the appearance of the monthly figures of the Producers' Association. In neither case was market action logical, nor would it in either case have been possible with a public in the market."

---o---

TECHNICAL PUBLICATIONS

So many weekly, fortnightly, and monthly periodicals are published nowadays which contain articles of importance to the mining fraternity, that it is quite out of the question for an individual to regularly subscribe to all of them, or even to more than glance through the files when a fairly complete library is available.

To obviate this difficulty the Engineering indices which appear in Engineering & Mining Journal, Mining & Engineering World, and Engineering Magazine are of great assistance, especially to the engineer so situated that technical libraries are out of reach. The Engineering Magazine alone regularly reviews and indexes monthly the contents of 173 publications, which does not include those devoted to geology and ore-deposits.

The Geologisches Zentralblatt, appearing fortnightly, contains abstracts of leading articles from publications in many languages, translated into German, French, English or Italian. Even articles appearing in the Russian language are reviewed, and at a glance one is able to see what of importance has recently come out, (on the subject of economic geology, for instance), in every land.

These indices make it unnecessary to subscribe regularly to a large number of technical publications, because with their help the marooned engineer is able to locate and acquire immediately any articles of special interest to himself. What is of importance to one reader may be of minor interest to another, and at the present day when technical matters are so highly specialized it is impossible that articles of permanent value should be confined to a limited group of publications or to any one language. Many will of necessity seek the light along lines of least resistance, and only through technical indices become known to engineers to whom they may be of interest.

No one can feel sure that he is posted on any particular subject until he has looked through the technical indices mentioned, and has ascertained what has

recently appeared under that heading. When an engineer neglects this precaution the complaint is unwarranted that he was uninformed because some article came out in what he is pleased to term a "backwoods magazine." Such an individual, if he inspects the lists regularly reviewed by prominent technical publications, will probably find many that are to him of the backwoods variety, but not necessarily so to others.

A plan that works well is to keep a small deposit with some house that makes a specialty of technical publications, so as to be able to send a post-card order for any desired book or periodical as soon as notice of it has been received. One engineer of our acquaintance has had dealings of this kind with a Leipzig house (Th. Stauffer, Universitaetsstrasse 26, Leipzig, Germany) for over thirty years.

MEETING OF A. I. OF M. I.

(Excerpts from Mining & Scientific Press Report.)

The San Francisco meeting of the American Institute of Mining Engineers was opened Tuesday morning, October 10, with an informal reception to the visiting delegates in the Red room of the St. Francis hotel. In the evening the Sierra Madre Club members were hosts at a cleverly appointed dinner in their clubrooms at 313 West Third street. The spirit of the occasion was well borne out by the invitation cards, a reproduction of a placard announcing, in straggling letters.

"NOTICE.

"This is the Camp of The Sierra Madre Club. It is Open to all Mining Men & Prospectors. The Flour and Bacon are cached on the Roof and the Water Hole is just back of the Cabin. Let Those who pass on this Trail help themselves."

Below was inscribed a further greeting and welcome to the members of the Institute by the Sierra Madre Club.

The evening, however, was not wholly devoted to merely lighter matters, and a lecture on the Los Angeles aqueduct by William Mulholland, chief engineer in charge of the project, was both interesting and instructive. The lecture was illustrated with many lantern slides showing different features of the work.

On Friday, October 6, the delegates were guests on an extended trip to points of interest near Los Angeles. The oilfields, the Soldiers' Home, the Redondo power house of the Pacific Light & Power Co., and the pleasure resorts at the famous beaches clustering about the city were some of the places visited. The trip was in charge of B. L. Dowell, traveling passenger agent of the Pacific Electric Railway company. The dinner was served in the unique "fish restaurant" of Hopburn & Terry at Redondo.

The first business session of the San Francisco meeting was called to order Tuesday afternoon, October 10. W. C. Ralston, as chairman of the local committee, in a few well chosen words welcomed the visitors, for whom Robert W. Hunt, vice-president of the Institute, responded happily in a short speech. The first official act of the delegates was the despatch of a telegram to President Kirchhoff expressing their regret at his absence, and their sympathy in his trouble, with their hopes for the prompt recovery of his mother, whose illness prevented Mr. Kirchhoff from attending the meeting.

The first paper read at the meeting, presented by E. B. Durham, was a well-prepared description of the electrolytic refining methods used in the United States Mint at San Francisco. This was followed by a paper by Bernard McDonald, who in his account of the "Parral Tank System of Agitation," gave a particularly interesting description of the improvements in practice he had worked out in the Mexican mills recently erected under his direction.

The geology, equipment, and method of working at Newport iron mine, Ironwood, Michigan, was described by B. W. Vallat. At this mine the sub-slicing system of mining is employed and in 307 working days in 1910 a total of 1,074,800 tons was hoisted through one shaft, an average of 3500 tons per day. The highest record was 6652 tons in one day, the average hoisting distance being 2150 ft., the maximum hoisting speed being 2200 ft. per minute, and the production was secured from four different levels. In discussion of this paper Gardner F. Williams called attention to the similarity of the mining system to that adopted at the Kimberley mine in South Africa in 1887, though at the latter no timber is used to form the top mat. The upper slice is caved as at the Newport mine, but the waste follows the ore directly. At Kimberley the hoisting is all done from one level, the material being dropped through winzes as much as 500 ft. to reach that level. There are two 10-ton skips for hoisting, these being run in balance. In separate compartments are cages for handling the 4000 natives employed. On August 4, 8514 tons were hoisted in 12 hours from the 100-ft. level, and August 11, 9098 tons. The highest previous record was 8433. In six days 48,000 tons has been hoisted. Material is brought to the loading station in one-ton cars hauled by an electric locomotive. The cars are dumped by the natives and trains of 32 cars have been handled without stopping the train which moves slowly over the bin.

In his treatise on the "Electro Deposition of Gold and Silver from Cyanide Solution," S. B. Christy gave a scholarly review of the work of the last dozen years on this highly technical subject. The paper contained much interesting material, but too complex to be summarized in the space available in this issue.

The technical session on Wednesday morning was opened by an intensely interesting paper on "California Oil," by Mark L. Requa, to which the secretary emeritus, Dr. Raymond, added pertinent and interesting discussion in which several other members joined. A representative of the Panama-Pacific Exposition welcomed the members of the Institute to San Francisco and requested their aid in making the forthcoming exposition a success. Tre papers on dredging by Messrs. Charles Janin and Francis J. Dennis were read by Mr. Dennis in the absence of Mr. Janin, and a brief discussion of dredging problems followed. This was followed by an interesting paper on the gold production of California, by Charles G. Yale, who has been so closely identified with the development of the mineral industry of California, and many of the members joined in the discussion which followed.

The secretary read a telegram announcing that a research scholarship would be established at Columbia University as a memorial to Sameul Franklin Emmons, as noted in the editorial pages of this issue. E. H. Benjamin announced that A. D. Foote, whom it was hoped would be present at the meeting, was undergoing a serious operation, and a resolution expressing the hopes of the members present for his safe and speedy recovery was unanimously carried. The morning session was brought to a close by an informal talk by Thomas T. Read on the mineral industry of China, illustrated by lantern slides, which aroused much interest.

At 2 p. m. Wednesday afternoon the party left the City by special train for a trip down the peninsula and a visit to Stanford University. At Palo Alto they were met by the Stanford members of the Institute and the students in mining, and taken by special cars and autos across the beautiful campus of the University. The shops, laboratories, libraries, and museums were inspected, after which on the roomy porches of the Delta Upsilon house the visitors were served light refreshment and informally met the men of the departments related to mining.

In a paper on the "Fritz Engineering and the Coxe Mining Laboratories of Lehigh University," Joseph Daniels, associate professor of mining engineering in that institution on Thursday morning told of the founding and equipment of the two laboratories. He remarked that the new ore-dressing laboratories of Lehigh are in the natue of a new departure, as, on account of its proximity to the Pennsylvania coalfields, the principal interest of the university has been in coal mining. With the new facilities it has been found that in spite of the fact that 90% of the students are drawn from coal-mining districts, only 10% of the students after graduation return to the coal-mining industry, the majority preferring metalliferous mining. R. W. Hunt, who was chairman, spoke at the dedication of the Fritz laboratory, remarked Mr. Daniels. In this laboratory, tests were made of concrete material, for the city of Scranton, and it is proposed to provide facilities for testing road material.

In a technical but intensely interesting paper on "Slime-Filtration,' George J. Young, professor of mining and metallurgy in the Mackay School of Mines, told of the data he had collected.

Reiji Kanda, a consulting engineer of Tokyo, a member of the American Institute of Mining Engineers, arrived on the Chiyo Maru on Thursday and spoke at the session as a representative of the Mine Owners' Association of Japan. He bespoke a warm welcome for the American engineers on their coming trip, in which he will act as escort.

A paper by H. Foster Bain, in which he advocated the leasing system of the Alaska coal-lands, and the opening of one mine by the Government, aroused some of the keenest discussion of the Institution. J. W. Malcolmson asked why it would not be advisable to permit the development of Alaska on the individualistic lines which existed during the development of the West. Mr. Bain pointed out some differences in the two problems and asserted that the men most interested in the coal-lands of Alaska were not residents there throughout the year. Edward W. Parker gave some interesting statistics regarding the consumption of coal in the United States and the production of coal in Alaska.

Dr. R. W. Raymond, who was acting as chairman, strongly disapproved of the course advocated by Mr. Bain. He affirmed that the United States Government is not capable of conducting the fuel business with the same certainty of method as private individuals, and said that the Government has no maps which show the mineral land still the property of the United States. The aim of the Government, he continued, has been to give every man a chance to own 160 acres of coal land, and not to interfere with his disposal of the land. But the Government lately has undertaken to add commandments to the decalogue, and to create crimes for which none need blush because denounced by some demagogic reformer. The United States, he asserted, in regard to the Cunningham claims, failed in its trust in not granting title to the claims. The main feature of the new law, he said, had been disregarded, in that stockholders in one coal company could not hold stock in a rival company. In the future some "Glavis Junior" might discover such ownership and associated stockholders would lose without appeal title in the lands. Federal taxation of any natural resources would subject citizens utilizing the resources to a handicap not experienced by the citizens of Texas, where the State of Texas and not the United States has control of natural resources. The people of the United States are drifting into a policy of opportunism, and the multiplicity of laws has made it impossible for industrious and ambitious citizens to know whether or not they are criminals under the law. We now have a lot of impossible cures for imaginary evils through recent legislation in individual States, but such legislation at least indicates that individual States can be persuaded to remedy evils, while it would be impossible to get a majority of the States to agree on any change in the Federal policy. Mr. Raymond's speech was interspersed with witty stories, and was greeted with applause.

Thursday afternoon the delegates visited the University of California. Dr. Raymond gave in the Greek theatre some "Reminiscences of the Beginning of the Institute," and G. T. Becker gave a biographical notice of S. F. Emmons.

On Friday many of the delegates went on an excursion to the gold dredges at Natoma. There they were entertained at a pleasant luncheon by the Natomas Consolidated company. After luncheon the dredges were visited and the rock-crushing plant at Fair Oaks inspected. On the return the delegates were guests at dinner of the San Francisco committee in the dining-car. Many of the ladies and delegates as well were visitors to many factories about the bay, where a cordial welcome was given them.

On Saturday afternoon the delegates left the St. Francis hotel at 1:30 p. m. in special sightseeing automobiles for a three-hour trip, stopping at Golden Gate Park to witness the ground-breaking ceremonies for the Panama-Pacific International Exposition in 1915.

On Sunday the members of the Institute and their guests, to the number of about 200, made an excursion to the Bohemian Grove, on Russian river in Sonoma county. After an hour spent in strolling about the grove, lunch was served, followed by an hour of music in the leafy amphitheatre.

On Monday evening the local members of the Mining and Metallurgical Society entertained the visiting members and prominent members of the Institute at a dinner at the Fairmont hotel. The dinner was followed by a discussion of the Alaska land laws, which was opened by H. Foster Bain, and in which Dr. Raymond, George Otis Smith, E. W. Parker, W. R. Ingalls, Charles G. Yale, M. L. Requa, W. C. Ralston, and W. L. Saunders joined.

On Tuesday morning, Oct. 17, the members of the Institute who are to visit Japan sailed on the SS. Manchuria, to return early in December, Joseph Struthers, the secretary, being in charge of the party, which is accompanied by Reiji Kanda, who came to San Francisco as the representative of the Japanese mine owners' association.

OPENING MINE LEVELS

It is now considered good practice to open mine levels 150 ft. apart, the distance being measured on the vein. In earlier years the distance seldom exceeded 100 ft. and was often less, but where the vein is found to be persistent in depth it has been found less expensive to increase the distance between the levels, the economy being in the saving of the increased cost of driving the levels at more frequent intervals, timbering them where necessary, and also the cost of the more frequent cutting and equipment of stations, where the mine is operated through a shaft. These are all more expensive than stoping.

It is obviously less expensive to open and equip eight levels than twelve, in going down a distance of 1200 ft. At one time the objection was urged that great distance between levels resulted in a greater expense in cribbing and keeping the mill-holes in repair, as the timbers of the cribbing would be completely worn out by the falling rock, and these had to be replaced at considerable expense and loss of time in the consequent interruption of the work, not to mention the danger to the men. Shrinkage stoping has largely remedied this difficulty and levels may now be 200 ft. apart as well as less.

Black powder is exploded by combustion, while dynamites must be detonated.

THE ELIMINATION OF OIL FROM RETURN FEED WATER

By C. E. CROCKER.*

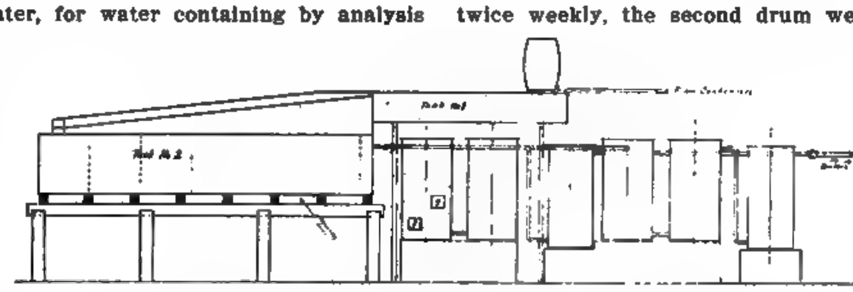
It is well known that any considerable amount of oil allowed to enter boilers with return feed-water is dangerous and destructive to the tubes and plates, but it is not perhaps so generally realized that oil is destructive even if admitted in very small quantities, and, by accumulating on the heating surfaces, it greatly reduces the efficiency of evaporation. It has been determined that the transmission of heat through a boiler-plate will be retarded more by a film of grease 0.001-in. thick than by ⅛-in. of scale. The oil also assists other deposits from the water to adhere to the surfaces, and necessitates more frequent cleaning. In most cases the cost of removing the oil before the water enters the boiler will be more than saved by the reduction in boiler-cleaning expense; but even if this is not so, the treatment is justified by the better evaporation obtained and the protection it gives the boiler.

Most of the free oil present in exhaust steam can be removed by one of the types of mechanical separators on the market; or where jet condensers are in use, the oil will float on the water in the tail pit or tanks and may be skimmed off, but that part of the oil that becomes emulsified and gives the water a milky appearance is more difficult to deal with, and cannot be separated even by passing through filter-paper. It is necessary to treat the water chemically, or otherwise to cause the oil to coagulate before it can be separated by filtration.

At the plant of the Kalgoorlie Electric Power and Lighting Corporation, Limited, several methods and arrangements of filters were tried, but they were found to be either ineffective or unworkable, on account of difficulties in dealing with the filters. An electrical method, which consisted of passing the oily water through a tank containing iron plates as electrodes, and submitting it to an electrical current equal to about 1.1 kilowatts per 1,000 gallons, was very effective in causing the oil to coagulate, but it had to be abandoned owing to the corrosion set up in the feed pipes and in parts of the boilers. This appeared to be due to electrolysis, although every care was taken to insulate the electrical portion from pipes, etc.

*In Monthly Journal, Chamber of Mines Western Australia.

The treatment now in use has proved to be very effective and cheap in working, and although it is not considered in any way novel, a description of it may be of interest to others who have similar conditions to contend with. The method consists of treating the oily water with alum and common soda in the proportions of approximately 0.35 lb. of alum and 0.30 lb. of soda per 1,000 gallons of water, for water containing by analysis 3.5 grains of oil per gallon of water. The quantities of chemicals would, of course, be varied to suit the amount of oil contained in the water. The apparatus employed in the treatment should have sufficient capacity to allow ample time for the chemicals to act on the oil. In the plant referred to about 50,000 gallons per 24 hours are treated. The capacity of the tanks and filters is such that five hours are required for the water to pass through. A longer time would probably be an advantage, and would reduce the consumption of alum and soda. As the precipitant formed is very light and easily broken up, it is desirable that the plant should be so arranged as to reduce the agitation of the water, as much as possible, in its passage through the tanks.



Apparatus for Eliminating Oil from Return Feed Water—Elevation and Plan

The alum and soda are each dissolved in the barrels A and S respectively, and the solutions are allowed to drip from the barrels and mix with the incoming greasy water in Tank 1. The water passes under and over baffles in Tank 1 an 2, and through a quantity of rough filtering material or firewood in part of Tank 2. Each of the drums in the four sets of filters, A, B, C and D, contains a bed of filtering material between the perforated trays indicated by dotted lines on one of the drums. This filtering material may be coke, charcoal, wood-wool, shavings, or any fairly open or porous bed Sand is most effective, but clogs up too quickly to be used in the plant mentioned. The Tank 2 has a cleaning door in the bottom, through which, after the water is drained off, the accumulation can be discharged. This tank requires cleaning monthly. The filter-drums are provided with drains and cleaning-doors, through which the filter-bed can be quickly removed and renewed. The first drum in each set is cleaned twice weekly, the second drum weekly, and the third fortnightly On entering the apparatus the water contains 3,500 grains, and on leaving 850 grains of oil per 1,000 gallons. The cost of chemicals amounts to 1.15d. per 1,000 gallons. The treatment has been in constant use some two years with satisfactory results, and the boilers are in excellent condition, requiring considerably less frequent cleaning than they did formerly.

The theoretic percentage of metallic copper contained in the various principal ores of copper, when pure, is as follows:

	%
Cuprite (red oxide)	88
Chalcocite (copper glance)	78
Malachite (green carbonate)	62
Azurite (blue carbonate)	61
Bornite (peacock sulphide)	58
Chalcopyrite (copper pyrite)	34

Official figures show the value of silver, silver lead, zinc concentrates, copper, tin, and coal exported from New South Wales during the first half of this year to have been £3,659,166, showing a net increase of £579,169 compared with the corresponding period of last year

COPPERETTES

It is stated in the east that a pool composed of southern bankers has been formed to finance the cotton crop and it is suggested by the Pittsburg Gazette Times that this means to hold the crop until 13 cents can be secured. If such a financial measure is possible in cotton, why not in copper also?—Exchange.

* * *

A bright idea; why not? For additional information consult one Secretan.

* * *

Nothing is quite so characteristic of the writings of Horace J. Stevens as the manner in which he compels the word "circa" to do overtime. He makes it stand for just "about" everything that is inaccurate or "approximate" in his Copper Hand Book, and which he does not personally care to "stand for." Therefore we should say that, had he been less biased or "boodled" in his nearly nine pages of Tom Lawson-George L. Walker "market letter" material concerning Utah Copper, the investing public might have been disposed to agree with "circa" all that was said. As the story looks and reads it is quite evident that "circa" all the data, as well as much, if not "circa" all the language of the recital, was supplied by the Utah Copper Company's own publicity bureau. But then—it costs money to issue works like the Copper Hand Book.

* * *

The Boston Financial News of the 17th instant says: "Bingham—Shipments amounting to 11,000 tons a day are now going forward over the Bingham & Garfield, the new Utah Copper railroad from this camp to the smelter at Garfield. The Denver & Rio Grande is carrying 7,500 tons also, a total of 17,500 (18,500) tons. The Utah Copper today is making the heaviest ore shipments in the history of the company."

On the same day, Oct. 17, Thompson, Towle & Co., in their News Letter, said: "We are in receipt of advices from the west stating that the Utah Copper Company is now shipping to its concentrators 15,000 tons of ore daily, one third of which is going over the company's new Bingham & Garfield railroad."

Mr W. B. Thompson, senior member of the firm of Thompson, Towle & Co., is a member of the Utah directorate and reputed large holder of pooled shares, and therefore no doubt receives his information from first hands, whereas the Financial News, like other members of the publicity bureau, must print whatever is supplied to it by the local office. Readers will, of course, take their choice, but we suggest that any one doubting the accuracy of the higher figures will be regarded as a "knocker."

* * *

"I figure that the world's output will increase about 8 per cent in 1912 over 1911, 5 per cent more in 1913, and not over 2 per cent annually in 1914, 1915, and 1916. If consumption increases again as it did from 1901 till 1906 copper may sell at 30 cents or higher in 1915 or 1916.—Geo. L. Walker's Weekly Copper Letter. (Copyright by Dukelow & Walker.) Cable address, "Dukelow," etc.

* * *

This carries the inference that the public should get into the Copper shares without delay. Walker is evidently trying to wear the hot-air pumps discarded by Tom Lawson, but he is yet a little timid and uncertain in his stride. To "figure" copper at 30c. a pound five years hence certainly gives the public ample time in which to forget just what Mr. Walker has said.

* * *

A great service has been rendered legitimate mining industry by J. R. Finlay through his disinterested report on the actual worth of individual Lake Superior mines. The value of this report lies in the fact that it was made by an experienced engineer to the Board of State Tax Commissioners of Michigan, and deals with facts: it can very well serve as a type of report which investors in mining stocks should insist upon having from mining districts.

* * *

Of course, many holders of stocks issued by Lake Superior mining corporations resent having the truth told about the particular properties in which they are interested, and publicly voice their dissatisfaction. This was to be expected: no one likes to be told that he has been separated from his money through the machinations of clever promoters But then there has to be an awakening from roseate dreams sometime!

* * *

If during the period of sixteen months, which elapsed from the close of its fiscal year 1909, to the date of issue of its annual report for 1910, the Utah Copper Company had actually developed—as shown by that report—over a hundred and ten million tons of ore, the existence of which was theretofore unknown to the shareholders, and which newly discovered ore was—according to its own rating—of the value of nearly a hundred million of dollars; and if, during the period in which this stupendous development was being made, all knowledge of the fact was carefully concealed from the public and the small shareholders until practically the entire capital stock issue had been gathered up by the inside or pooled interests, as stated by this journal at the time, what assurance can present investors have, that, as soon as the holdings of the insiders are unloaded on the public, the entire alleged supply of ore may not as suddenly disappear, or cease to yield profitable returns until such time as the insiders may again gather in the floating shares at greatly reduced prices, and so continue to repeat the process ad infinitum?

* * *

"Mines and Methods," pulished in Salt Lake City, comes to us without one single advertisement. It states that its criticism of the Utah Copper Company has caused that concern to go after its patrons and force them to withdraw their patronage.—Los Angeles Mining Review.

* * *

Yep! And we are not going to file a petition in bankruptcy, either.

* * *

The Mining & Scientific Press is irritable because Mines and Methods presumes to present its readers with high class technical information and at the same time boldly criticise the methods of those who pose for pelf as great engineers, mine managers and metallurgists. All we can say in reply at this time is: "Don't worry yourself sick on our account, dear old Sister Press; everything will come out right in the end. "For our part," we must insist on presenting information on subjects that interest and concern our readers in our own way. When we get ready to do things in the old, stereotyped fashion followed by the Mining and Scientific Press and other self-styled 'technical' journals, we'll call in a new doctor."

* * *

There has been no denial of the statement published in the last issue of Mines and Methods, "that the closing down of the work of enlarging the Arthur plant of the Utah Copper Company, after completing only six of the thirteen sections, was due entirely to lack of funds with which to continue the work." We therefore call the attention of Walker's Weekly Copper Letter to this trivial omission. It will be remembered that all work of reconstruction of the Arthur plant, as indicated above, was suspended about

September 15th and that the manager explained shortly thereafter in effect "that the work would not be resumed during the winter months or until the supply of available ore should render increased milling capacity necessary." Perhaps this explanation makes it unnecessary to undertake to show the presence of a large surplus where none exists.

* * *

Complaints are appearing in the press that while Utah Copper and Ray Consolidated Copper shares have been marked down fifty per cent, still the public is taking them very sparingly. We would respectfully suggest to the sales-agents of the syndicates' that perhaps the servant girl class would become more interested in their wares if they were advertised for sale on easy payments. Might try five per cent down and fifty cents per month until paid for.

* * *

It is not a popular occupation—telling the truth about mining schemes. It arouses in particular the enmity of wealthy promoters, and of sales-agents employed to distribute their engraved share-certificates of incorporated dreams. There is more pecuniary profit in assuming the role of promoting-engineer, and in assisting the distribution of stock through getting interviewed by newspaper reporters, and in other ways. For this reason the position taken by Mr. Finlay will meet with approbation by honest men generally.

* * *

It is said that at the great packing houses in Chicago there are animals which lead an easy existance by acting as decoys for their fellows, cheerfully heading the procession destined for slaughter, but effecting their own escape at the proper moment. Such conduct is not pleasing even in the lower animals: what can be said about human animals, who knowing better themselves, publicly boost the sale of engravings which represent fictitious values (at the price asked)? Mr. Finlay, through his report on the Michigan mines, demonstrates that he occupies a position over and against the decoys.

* * *

Mr. Finlay says: "Stock-market valuations are not considered. It will be observed that this method (of camputing worth of properties) makes no mention of quoted values. * * * Mining stocks do not represent anything definite. Some pay dividends, in which case their quotations are comparable with those of other securities, but in the majority of cases mining stocks represent nothing more tangible than hopes." Then continuing, and possibly having in mind some of the porphyry coppers, Mr. Finlay's report reads: "Still it is doubtful if much of these stocks is sold to a gullible public. They are mainly bought and sold by seasoned gamblers with whom it is a case of "dog eat dog' ".

* * *

"The placing in commission of the (Utah Copper) company's railroad comes at a very opportune time, as the work of enlarging the concentrator has proceeded to such an extent that an increased tonnage can now be handled, and this tonnage transported over the company's lines, thereby resulting in a considerable saving in freight."

"Under the new contract of the Utah Copper Company with the D. & R. G. W. Ry., 7,500 tons (daily) will be hauled by that line. Any tonnage OVER AND ABOVE this amount will be handled by their own railroad. The additional equipment and rolling stock which has been ordered for the new line should be at the property in sixty to ninety days, at which time the company will be in a position to handle any tonage required by the concentrator."—Thompson, Towle & Co. News Letter, Oct. 17, 1911.

At the present claimed rate of shipment of ore from the Utah company's mines—15,000 tons a day—the new Bingham & Garfield railroad would have available for haulage 7,500 tons per day, upon which there would be a possible profit, according to official estimate, of 8 cents per ton or $600 per day, and $219,000 per year. The cost of the road and equipment is conceded to be in excess of five million dollars, the annual interest on which, at six per cent, will amount to $300,000, being $81,000 per annum in excess of net earnings. It is hoped, however, that the prestige of owning its own railroad will more than compensate this apparent loss by the impetus it will afford manipulation of the share market.

UTAH INCREASES COAL OUTPUT

The value at the mines of Utah's coal production in 1910 was $4,224,556, with an output of 2,517,809 short tons, according to E. W. Parker, of the United States Geological Survey.

Compared with 1909, when the coal production of Utah amounted to 2,266,-899 short tons, valued at $3,751,810, the output in 1910 showed an increase of 250,910 short tons, or 11.07 per cent, in quantity, and of $472,746, or 12.6 per cent, in value. Utah's production in 1910 was affected only indirectly, if at all, by the coal strike in the Middle West—that is, by the demand created on the mines of Colorado and New Mexico, which possibly reduced the competition of coals from those States in markets to the west and southwest reached jointly by them and the coals from Utah mines. This increased production of Utah coals is looked upon as only an indication of normal growth that may be expected to continue as the country develops in population and industrial enterprises.

The year was one of general prosperity, says Mr. Parker, to both operators and miners. Production increased, prices advanced, and although there were no strikes for higher wages or changed conditions, some of the coal-mining companies voluntarily gave an advance of 5 per cent in the wages of their employees. During August and September, when the crops were being moved, there was a shortage in car supply, but as a general thing throughout the year transportation facilities were adequate.

The number of men employed in the coal mines of Utah in 1910 was 3,053, and that they were kept steadily employed is shown by the fact that each man averaged 260 working days. The average quantity of coal mined by each man employed was 824.7 tons for the year, or 3.17 tons for each working day.

Tempering of copper is popularly supposed to be "one of the lost arts," but as a matter of fact is one that was never possessed to any higher degree than at present. It is safe to say that copper has never been tempered at any time by anyone, as it does not possess the necessary properties. Copper can be hardened in a number of ways; the easiest being to plunge the finished article into molten antimony or arsenic; the resulting alloy formed on the surface is exceedingly hard and brittle. Recent research in Mexico has shown that the tools there supposed to be made of hard copper were made by smelting mixed ores of copper, nickel, and cobalt; the resulting alloy, something like monel metal, was naturally hard. None of these old tools are of a quality equal to those which can now be made.—Mining and Scientific Press.

For the benefit of those who may search for phosphate rock the following simple test is given: Place a small crystal of ammonium molybdate on the rock to be tested, then drop a little dilute nitric acid on the crystal. If the crystal turns yellow, it indicates the presence of phosphorus. The deeper the yellow, the higher the phosphate content.—Mining Science.

ECONOMICAL METHOD OF SHAFT TIMBERING

By HUGH G. ELWES.*

The scarcity of timber in certain districts has led mine operators to try to use timber of less dimensions than those commonly employed in places where lumber is plentiful and consequently cheap.

The Nevada camps, especially Goldfield, are examples of places where the smallest timbers compatible with safety have been used. The light sticks used have been thought too weak by some, but practical experience has shown that all purposes have been well served and no failures of timbers have been recorded.

The writer ventures to suggest that in very many cases timbers much larger than those required are used. Beside the extra cost of big sticks, the lost space in the shaft is an objection, and in a large number of instances the timbering of the shaft is necessary only to support guides, ladders pump lines, etc. A shaft in anything like good ground needs only light timbers such as those shown in the drawings, and if properly wedged, the latter, in combination with continuous lagging, will prevent rocks falling into the shaft as well as heavier sticks and at much less cost.

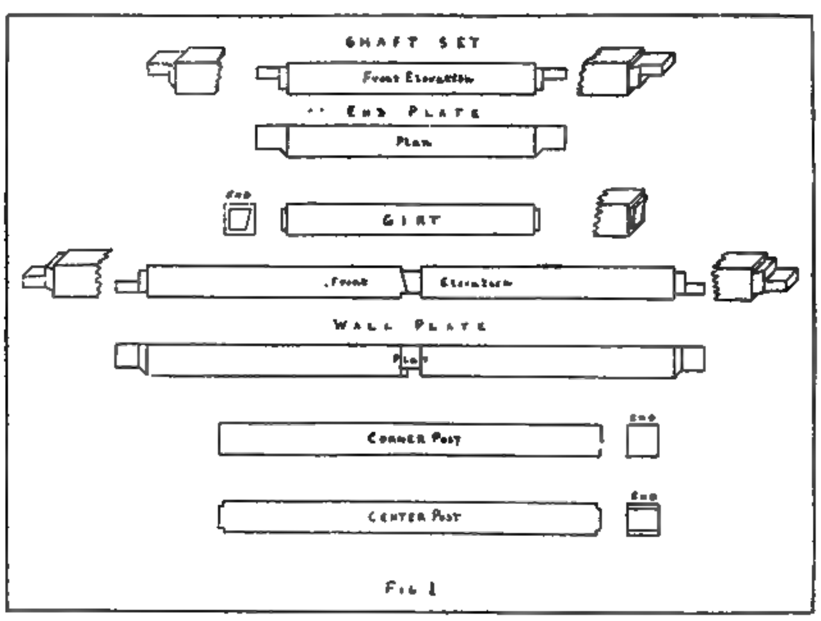


Fig 1

The drawings show the framing of timbers for a small two compartment shaft, each compartment measuring four feet by four feet in the clear, inside the timbers. All the sticks are six inches by six inches, except the special wall plates at the collar, and the special end plates of the bearer set which are six by tens.

Referring to Fig. 1, it will be seen that the end plates fit above the wall plates, and that both have a beveled shoulder to afford additional resistance in resisting side pressure. Daps are cut, one inch deep to receive the ends of the corner posts. These corner posts have plain squared ends but the center posts have a one inch tenon fitting into the dap in the wall plates as shown.

The girts have a one inch tenon beveled on one side, which is always the right hand side in end elevation. The wall plate is framed as shown, so that all are the same, without any right and left hand plates, and any girt can be put in in either direction.

The dap in the center of the upper and lower sides of the wall plates is so framed that girts and center posts can be temporarily omitted to permit the lowering and swinging into position of the wall plates.

The small perspective drawings of the ends of the various sticks are given to make the framing more intelligible.

The distance between sets is six feet in the clear or six feet six inches centers.

In framing, all measurements should be governed by the upper side and the inner face of each stick, so that any irregularities in them will not affect the alignment of the shaft nor its inside dimensions.

Figs. 2 and 3 show respectively perspective views of the skip compartment and ladder way, since a drawing showing the whole shaft would be too large for convenient use.

To avoid confusion the hanger bolts are shown only in the drawing of the skip compartment. These hanger bolts are of one inch round iron, ordinary nuts being used with extra large washers. Holes are bored in the wall plates nine and eighteen inches from the edge of the end daps, and the hole nearest the end is useful in lowering the stick, since a short piece of round iron passed through, having a thread at each end makes a convenient means of suspending the timber. The lagging of one inch boards is not shown so as to leave the drawing simple. Needless to say this lagging is placed outside the timbers, though the writer saw a shaft in New Mexico lagged on the inside, making a rectangular tube.

In Fig. 2 the guides are shown. These are made of two by four inch lumber and engaged dogs on the cage or cross-head.

*Mining Engineer, Papantla, Veracruz, in Mexican Mining Journal.

UTAH MINE PRODUCTION FOR CALENDAR YEAR 1910

The total value of the mine output of gold, silver, copper, lead, and zinc in Utah in 1910, according to V. C. Heikes, of the United States Geological Survey, was $32,199,185, against $31,380,092 in 1909.

The total gold production in Utah in 1910 showed a decrease in value of $174,-463, or 4.3 per cent. The largest producer of gold was Salt Lake County, which yielded $1,776,058, against $1,780,-573 in 1909. The West Mountain or Bingham district produced $1,767,992 of the gold credited to Salt Lake County and 43.8 per cent of the 1910 Utah gold output. Juab County produced $1,181,-366 in 1910, against $1,448,096 in 1909, and Utah County $193,234 in 1910, against $276,314 in 1909. The Tintic district, which is partly in Juab County and partly in Utah County, produced $1,370,-320 or 34 per cent of the gold production of Utah in 1910. Tooele County produced $721,361 (of which all except about $5,000 came from the Camp Floyd district) in 1910, against $820,486 in 1909.

The silver production of Utah in 1910 showed a decrease of 1,250,201 ounces, or 10.7 per cent. Juab County produced 3,835,062 ounces in 1910, against 3,544,918 ounces in 1909, and Utah County 1,500,625 ounces in 1910, against 2,995,658 in 1909. The Tintic district silver yield declined from 6,404,-847 ounces in 1909 to 5,222,742 ounces in 1910. Salt Lake County produced 2,006,-131 ounces in 1910, against 1,780,572 ounces in 1909. Of the Salt Lake County yield, the West Mountain or Bingham district contributed 1,800,410 ounces in 1910 and 1,615,394 ounces in 1909.

The silver output of the Park City mining region in 1910 was 2,571,771 ounces, a decrease of 253,614 ounces, or 10 per cent, from that of 1909.

Copper production increased in Utah 18,649,261 pounds in 1910, a larger increase than in any other of the copper-producing States. The Bingham district produced 113,725,280 pounds of copper in 1910 against 92,560,340 pounds in 1909, 71,155,740 pounds in 1908, and 45,431,964 pounds in 1907. The Tintic district yielded 8,993,036 pounds in 1910, against 5,915,669 pounds in 1909, an increase of 3,077,367 pounds. The Park City district, in Summit and Wasatch counties, produced 1,423,629 pounds in 1910, against 1,655,749 pounds in 1909.

The production of lead in Utah in 1910 was 123,324,635 pounds, valued at $5,-426,284, against 148,486,463 pounds, valued at $6,384,918 in 1909. Of the 1910 output, 30.9 per cent was derived from mines in the Park City district, which produced 38,129,761 pounds, against 46,350,390 pounds in 1909. The Bingham or West Mountain district produced 30,-271,016 pounds in 1910, about the same quantity as in 1909, and 24.5 per cent of the total Utah lead output. The Tintic district, which yielded 56,502,209 pounds of lead in 1909, produced only 37,553,455 pounds in 1910. This district yielded 38 per cent of the Utah lead in 1909, and only 30.4 per cent of that in 1910.

The zinc production of Utah was 16,-367,104 pounds, valued at $883,824, in 1910, against 9,860,778 pounds, valued at $532,482, in 1909. This shows an increase of 6,506,326 pounds or 66 per cent. The Park City mining district alone produced 9,437,992 pounds of zinc in 1910, against 6,737,237 pounds in 1909. This district yielded in 1910 over 57.7 per cent of the total zinc production of Utah. The Bingham district was also a large producer and increased its output from 649,542 pounds in 1909 to 3,572,347 pounds in 1910. Tooele County, which produced 2,843,032 pounds, and Beaver County, which produced 513,733 pounds, were the only other counties in Utah reporting a production of zinc in 1910. The zinc in concentrates, amounting to 12,959,422 pounds, all came from Salt Lake, Summit, and Wasatch counties.

There were 183 mines producing gold, silver, copper, lead, or zinc in 1910, against 179 in 1909. Of these, 8 were small placers. The number of producing mines in the Bingham district was 31; Tintic, 40; Big and Little Cottonwood, 17; Park City, 17. The total quantity of ore sold or treated in Utah in 1910 was 6,389,398 short tons, an increase of 1,266,809 tons. The average total recoverable value per ton was $5.02 in 1910, against $6.12 in 1909. The lower average value per ton was caused by the large increase in copper ores, of which 5,417,558 tons were sold or treated in 1910. This quantity was 84 per cent of the total ore treated and an increase of 1,201,332 tons over the 1909 production of copper ores.

Of the total tonnage of all classes of ore 263,041 tons, mostly from Tooele County, went to gold and silver mills, 5,182,057 tons, of which 4,937,285 tons were from Bingham district, went to concentrating mills, and 896,834 tons were sent to smelters.

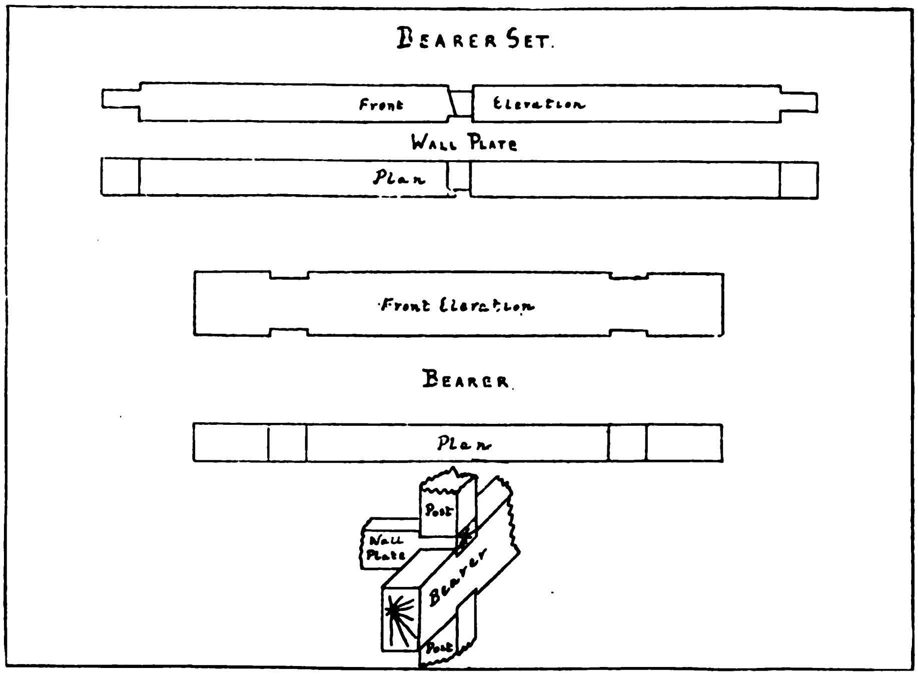


Figure 6 of Article on Preceeding Page

Consul Frederick Simpich writes from Ensenada that a $200,000 California corporation has started quarrying onyx in the Sierra Blanco peninsula, Lower California, about 200 miles south of the international boundary. Thirty men are now employed in the company's quarries and monthly shipments will be made from the landing at San Jose. This Mexican onyx lies in flat ledges close to the surface.

THE NEW YORK
PUBLIC LIBRARY

ASTOR, LENOX AND
TILDEN FOUNDATIONS

THE NEW YORK
PUBLIC LIBRARY

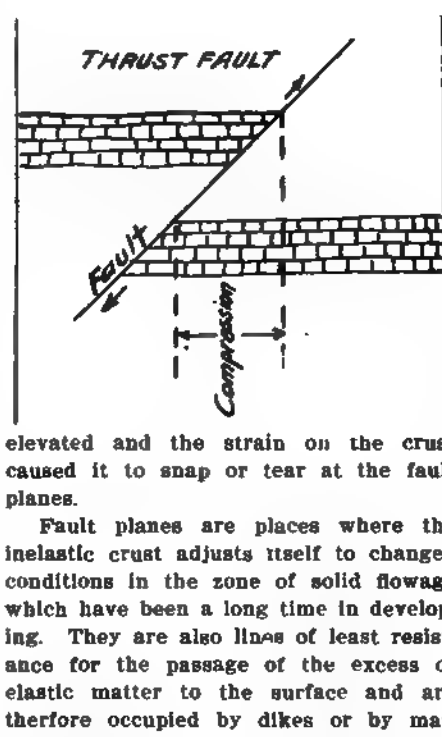
ASTOR, LENOX AND
TILDEN FOUNDATIONS

range south of San Francisco, increased in volume after the earthquake and some creeks on the west side were nearly doubled. All the streams were muddy for several days after the earthquake. A market effect was produced on the ARTESION BELT near the head of San Francisco bay. Wells that had previously been dry began flowing, and wells that flowed before the shock greatly increased in volume and pressure. A well near Alviso, at the head of the bay, formerly required a wind mill to pump the water. At the time of the earthquake the casing was driven 2 feet out of the ground, wrecking the pump, and since that time the well has been flowing under a heavy pressure." These flows of water appear to have been due to condensed steam as the temperature was raised, and the horizontal displacement due to the relief of earth strain while the walls of the fault were thrown apart by the steam.

When in the process of time and repetition the dike is advanced to the surface, the material blows out as lapeli, pumice or scorea and is usually highly silicious as it has been derived from a silicious magma long in process of making by the infiltration of silica into the rocks through which it has finally melted and fractured its way to the surface. Subsequent eruptions will be less and less silicious if derived from the same fissure until by the process of displacement and rise from great depth under the impelling force of the supersaturated steam, basaltic material is brought up to complete the cycle of eruptions which gradually come to a close because of the liberation of a great local accumulation of steam which has required much greater length of geological time for accumulation than for its escape. The fissure eruption differs from the crater eruption in quantity of material discharged and also in the lavas always being basaltic in character with a much greater fluidity and lower fusing point. They are supersaturated with steam in the same manner, which reduces their density to less than that of the overlying rocks and when a fissure is opened by tearing of the crust by the tension of the steam under the accumulated differential pressure, the lava continues to well up and discharge from the fissure until by the escape of the steam the density of the mass which has been left behind and in the fissure is equal to that above, and the eruption stops and another period of accumulation follows when the eruption is repeated from the same fissure or a new one formed.

FAULTS AND FISSURES.

The normal fault which as its name indicates is the most numerous type of faults, can be explained on the theory that after the rupture of the crust by the tensional pressure of the supersaturating steam in the peaks or ridges in the top of the zone of solid flowage, one of the regions on either side of the fault has had the density reduced more than the other and after the rupture that side of the fault remains permanently higher than the other. In the case of the Sonora earthquake of 1886, there was a vertical displacement of several feet on each side of a range of mountains, the mountains being elevated en block, which would indicate that the density beneath the region elvated was reduced more than that which was not



elevated and the strain on the crust caused it to snap or tear at the fault planes.

Fault planes are places where the inelastic crust adjusts itself to changed conditions in the zone of solid flowage which have been a long time in developing. They are also lines of least resistance for the passage of the excess of elastic matter to the surface and are therfore occupied by dikes or by matter deposited from solution, by replacement of the walls if they happen to be of a soluble nature, or by mineral matter deposited from solution by reduction of temperature and pressure. The elevating force is the same elastic pressure of the gases of low critical temperature which have accumulated under the differential pressure corresponding to a much greater depth than where they may have caused the rupture.

This differential pressure has now a practical application in compressing air at waterfalls, two of which are in operation, one on the Montreal river near Cobalt, Ont., and the other in Northern Michigan or Minnesota.

Shafts are sunk above and below the falls to a depth corresponding to the air pressure desired. Those shafts are then connected with a horizontal tunnel at their bottoms and a dome chamber is cut out in the roof of the tunnel from which a pipe (with the end opening into the top of the dome) leads to the surface to take off the air that separates from the water in the dome. If air at 130 lb. per square inch is required then the shaft above the falls must be about 350 feet deep if the falls are 20 ft. high, which will make the shaft below the falls 330 ft. deep. The water will rise into the dome probably 10 ft., which will make the air under a differential pressure of 320 ft. and deducting 20 ft. for loss of head due to friction, etc., the air will be delivered at the surface under a pressure of 300 ft. of water which at 0.44 lb. per foot will give 132 lb. per square inch.

Air is admitted with the falling water into the shaft above the falls and carried down by it to the dome in the tunnel, where it separates and comes up the air pipe while the water rises up the discharge shaft into the river below the falls. The air pressure depends entirely upon the depth of the shafts and not upon the height of the water falls.

The pressure of the air is governed by the depth of the point of separation between the air and the water in the dome in the tunnel connecting the bottoms of the shafts and is the difference between the weight of a column of water from the surface of the discharge down to the surface of the water in the air dome, and the weight of the air through the same depth. The water is supersaturated with air and only the air above the point of saturation in the dome is available for discharge as compressed air, the air dissolved in the water escapes with it into the river. The principle involved is exactly the same as in the case of the gases of low critical temperature supersaturating the material in the zone of solid flowage.

The fact that the material in the zone of solid flowage is solid and not liquid, makes no difference because at the temperature and pressure in that zone the solid matter behaves like a thick viscous liquid or like ice in a glacier, which is solid but still able to move and readjust itself to changes of pressure or distorting influences, allowing contraction to take place throughout the interior and only locally in the crust as it does in mountain ranges. The zone

LEACHING APPLIED TO COPPER ORE*

Thirteenth Article Reviewing Results Accomplished, With Special Reference to the Laszczynski Process and Its Adaptability to Small Leaching Operations.

By W. L. AUSTIN.†

On April 19th, 1904, there was issued to Stanislaw Laszczynski of Kielce, Russia, U. S. Patent No. 757,817, covering a "process of electrolytically extracting copper and zinc from ores." The essential feature of this patent is the use of insoluble anodes, tightly wrapped in thick cotton or other texture (flannel), in electrolyzing a sulphate lixivium. This texture constitutes a permeable envelope, the thickness of which must be in inverse proportion to the applied density of current, (as will be explained further down), and serves to prevent anodic oxi-

and roasted, with a view to getting a product containing copper-oxide and sulphate. The roasted ore is then again crushed fine before lixiviating with dilute sulphuric acid, whereby, (provided the roasting has been properly conducted), all the copper is said to go into solution in the form of sulphate. The lixivium is then subjected to electrolysis, using insoluble lead anodes and copper cathodes, and current is applied until no more than traces of copper remain in the electrolyte. While copper is being deposited at the cathode, a corresponding quantity of

at the same time to diminish losses when treating sulphide ore, roasting should be conducted in such a manner that only ferric oxide is produced, which of course is insoluble in weak acids. However, even when exercising every precaution, roasting cannot be carried to theoretical perfection, and a certain quantity of iron invariably passes into solution.

Even when the first solution off the ore contains a quantity of iron so small as not to materially interfere with the operation, nevertheless the proportion grows [illegible] until finally
te dissolves
ode as the
ay, deposi-
nder usual
d prevents
viant with
discarding
e imprac-
vil it has
lutions be-
rolysis by
cium car-
rate thus
notable
ct renders

ms in the
some ex-
ron salts,
ding the
dilute sul-
ents con-
he ferru-
. Never-
s its dis-
the ap-
rate cur-
sponding
de and
tly hap-
ring the
he vats.
electro-
Further-
ted with
plicated,
ch work
electro-
ms are
practical
he pres-
ch con-
re pos-

Thompson, Towle & Co., in their weekly news letter—an official organ of the Utah Company—published the following:

"A preliminary estimate of Utah Copper's operations for the year 1911 places the gross production of copper at 98,000,000 pounds, and the net production, after allowing for smelter deductions, etc., at 93,000,000 pounds. This latter figure compares with 1910 net production of 85,644,511 pounds, or an increase for the year of approximately 7,350,000 pounds."

It will be observed that the actual yield of copper by the Utah company, as officially estimated at the close of the year, fell short of the estimate of Manager Jackling—made a few months previous—by fifty-seven millions of pounds, or THIRTY-EIGHT PER CENT. The only remarkable feature of this fact, however, is the striking relation which it bears to the shrinkage in grade of the "sixty-two millions of tons of TWO PER CENT ore," so frequently mentioned in the manager's earlier "Reports," which later shrank to about one and one-quarter per cent copper, being almost exactly THIRTY-EIGHT PER CENT, and what is still more remarkable, the volume of ACTUAL ORE was found to depreciate in even greater ratio; but the deficiency was partially made good in the masterful acquirement of the Barnsdall-Pay Roll claims, as related in this journal for December, 1910. It may be observed, however, that whilst Manager Jackling's estimate of the quantity and quality of the ore and—as a consequence—the yield of metal has been slightly at fault, it is believed that the "potential condition" of the several elements named has remained fairly constant.

WORKING BOTH ENDS

Under the caption, "Workmen are Prey of Labor Agents; County Attorney Investigating Charge, Asks Mining Companies to Take Action," the Bingham-Press-Bulletin of recent date publishes the following:

Complaints have been made to the county attorney that Greeks and other foreign laborers employed by the Utah Copper Company and the Bingham & Garfield Railroad Company have been compelled to purchase their jobs and pay tribute to labor agents to hold them. County Attorney I. E. Willey yesterday directed letters to the two companies, calling their attention to the fact that such practice constitutes practical slavery, and is in violation of the constitution and statutes of the state of Utah on peonage.

The letters cite the law which makes such a system of tribute from laborers a felony, and calls upon the proper officials to take immediate steps to put an end to the system.

The action of the county attorney was brought about through a letter received from John H. Stampolas, secretary of the Independent Grocery company of Bingham, and upon information which has been laid before him by residents of Bingham.

The letter from Stampolas charges that a well-known labor agent of Salt Lake, who furnishes foreign laborers for mining and railroad companies in Utah and adjoining states, requires Greeks who secure jobs from the Utah Copper company to pay him $20 to get the job and $1 a month for each month they work.

It is alleged that if the laborers fail to keep up their monthly tribute payments they are discharged.

The same conditions are said to exist with reference to the Bingham & Garfield Railway Company.

Mr. Willey believes that the companies when their attention is called to the violation of law, will have the proper officials take hold of the matter and see that this system is stopped.

The method of supplying corporations and contractors with foreign labor related in the foregoing, is not new or unusual in Utah and other Western States. In fact, the custom has come to be regarded by those who employ large numbers of laborers of that class as essential, because of the fact that these people, aside from being enrolled as regular members of "labor unions," are also under a system of peonage absolutely controlled by a padrone upon whom they depend solely in all matters of securing employment and to whom, in addition to a fee, paid on entering employment, they pay weekly or monthly contributions, according to conditions involving the positions secured for them. But this is the first instance of which we have ever heard wherein failure to pay "monthly dues" subjected the victim to peremtory discharge by the employer. Such condition could only be enforced by the connivance and participation of the manager or superintendent of the business or corporation employing such labor.

It would be interesting to know what manner of reply Manager Jackling or his assistant, Mr. Gemmel, of the Utah Copper Company, or Mr. Chief Engineer Goodrich, of the Bingham & Garfield Railroad Company, will make to the letters of inquiry said to have been addressed to the officers of these companies by County Attorney Willey. But it is safe to assume that this will never be made known to the public and that there will be no prosecutions or other unpleasantries to disturb the very cordial relations which exist between the management of the Utah Copper Company and all important State and local officers.

It will probably surprise some of our citizens to know that while very few of these foreign laborers can speak or understand a word of the English language, and are only known or designated by their employers by a number on the "tags" which they wear or carry when at work, yet many of them are full-fledged American citizens. In this connection a ludicrous if not amusing incident occurred—shortly prior to the last general election—during the progress of the trial of an important case in which the Utah Copper Company was a party. It appears that on two occasions during the trial squads of these foreigners—in the employ of the Utah Copper Company—were brought into court and put through the form of naturalization, the trial of the case being suspended by the court pending the more important process of equipping some thirty illiterates with the right to vote at an important election at which the court judges were to be selected.

No, there will be no prosecutions on account of "graft" imposed upon the Greek laborers, and the process will be continued just the same; but the Bingham newspaper—for its indiscretion—will probably find its subscription and advertising patronage greatly diminished.

COPPER STOCKS AND METAL

Every day, almost, witnesses a new batch of "publicity" being ground out by the market-boosting machines which are such an important part of the Utah Copper-Ray Con.-Chino companies' "visible supply" of assets, or equipment. This stuff is becoming almost as nauseating and equally as copious as the mass of stuff that used to be worked off on the public during the Nevada gold boom days as news. It is being compiled and distributed in cunning fashion, because governmental investigations are more in evidence than they were a few years ago, but the public are still refusing to take the bait. Stock that will earn "$8.50 a share for thirty-seven years" is not wanted at $56, or $50, or even $38 or $75, because the public has learned and is wise enough to realize that the present owners of such stock would not part with it at any price if the representations made were true.

There also is considerable doubt as to the correctness of the statements being put out concerning the market absorption of copper metal, as indicated in the following abstract from the Mining and Scientific Press' New York correspondence, which appeared on the 13th of the present month:

"In copper there seems to be a good deal of underlying skepticism concerning the recent upward trend in prices. Some of the large consumers are questioning the soundness of the situation and the movement in the shares hardly justifies the fears expressed by some of the producers of a runaway market. While it is not known as an absolute certainty that a pool of big producers was formed during the latter months of last year, it is so asserted in some quarters, the story being that the group included some of the more important foreign agencies, and that a large amount of copper has been accumulated in an endeavor to stampede the American manufacturer into the market. Discussion of the topic with manufacturers reveals the fact that many of them were, and are, uneasy over the prospect of higher prices and no metal on hand, but, while the report of the Producers' association for December, 1911, was expected to make a strong showing, there was a tendency to await developments. If it be true that a group of copper producers working with the larger selling agencies has purchased and is now

ig any large part of the copper is supposed to have gone into conion, if the decrease in the world's supply proves eventually to be ac-d for in this way, it is safe to say n the end the copper market will more than it will gain."

UTAH COPPERETTES

E. Hazen, representing the Boston Bureau and the Wall Street Jour-as in Salt Lake for a day or two the middle of the month. He rode Bingham over the $5,000,000 Bing-nd Garfield railroad, it is reported, to see if the steam shovels are still rk removing the capping from the Copper Company's side of the tain of copper ore' on to the op-side, owned by Colonel Wall, and isfy myself that the Utah Copper any really and truly has enough ore $8.50 a share per annum, on a 15c. r market, for thirty-seven years." Salt Lake Mr. Hazen expected to go r, from there to Mason Valley, and down for a visit to the Ray Consoli-, Inspiration, Chino and other prop-.

* * * *

t the (Utah Copper) mine between y and twenty-five big steam shov-re in operation. It is said that time one of the scoops digs its iron teeth into the porphyry tain it lifts at least $10 worth of r and dumps it into a car. Aver-the copper content at 1.5 per cent is thirty pounds of copper per ton. scoopful holds several tons. Five would contain 150 pounds of cop-which, at 14c. a pound, is worth —Salt Lake Herald-Republican, 12, 1912.

id to continue the method of lating, (a la George L. Walker)), tons would contain 300 pounds, $420, and 1,000 tons would con-3,000 pounds, worth $4,200, while scoop of ore containing 3 per cent r at 28c. per pound, or one train-of ore carrying 15 per cent copper, the market at 38c. per pound, it might be by 1915 or 1930, would the figures read like real business being done. When you undertake gure on the future value of Utah er don't be timid or weak-kneed. Go after 'em.

* * * *

mysterious new concentrating de-is now being tried out at the Magna of the Utah Copper company. The rt gang of farmers, cowpunchers "relatives" which now constitutes subordinate directing force at the mill—or that portion which is still raid of its voice—appears to be at a just bow to describe the new-led machine. One, better versed in the names of concentrating machinery than most of the others, says the thing is generally known at the works as "the big drum," which is "a cross between a Cornish buddle and a Callow tank, set wrong end up." It is said to be automatic and absolutely costless in operation and when the intermittent, steady, heaving, pulsating and other features of the rotary and horizontal movements of the "big drum" have been sufficiently brought under subjection it is expected that almost limitless numbers of snare drums can be washed over the rim and saved. These snare drums will be carefully dried and tuned and then shipped and distributed to the various stock market centers of the world, where they will be utilized in making a big "noise" in support of the advancing prices that will be given to Utah Copper shares when the real "unloading" game is being worked on the suckers of London, Paris, New York, Boston and Salt Lake.

KANSAS SMITES THE FAKERS

The Boston News Bureau of recent date, under the caption of "Putting the Vultures to Flight," in caustic language approvingly comments upon the so called "blue sky law," recently enacted by the legislature of the "long-suffering" State of Kansas, as follows:

Massachusetts, at suggestion of its bank commissioner, is thinking of following where Kansas has led.

"Bleeding Kansas" has now become doubly historical, in the past tense. Its pocketbook is no longer freely bled by vendors of fake "securities." These vampires have been banished from the sunflower state.

The ban is the unique "blue sky law," passed last March, which seeks to protect the people's investments by safeguards akin to the supervision and guaranty that the state extends to banks. The law was fathered by its present administrator, Bank Commissioner Dolley, who previously had been unofficially advising Kansans against piratical promoters who would sell even the "blue sky" to the increasingly opulent farmers.

This curious and drastic act provides that any concern offering securities other than government or Kansas state or city bonds, or mortgages, shall file detailed statement of plan of operation, organization, contracts with investors, financial condition, property, and any other information the commissioner may ask. If he finds it solvent, and its proposals are "fair, just and equitable" and "promise a fair return," he shall permit it to do business —bold type declaring this not a recommendation—otherwise shall exclude it. Condition must be reported semi-annually, beside monthly trial balances available to investors, and investment agents be registered yearly. The commissioner has the same power of examination as over state banks, may compel a physical valuation, and may urge receivership if assets fall below liabilities. False statements are punishable by fine of $200 to $10,000, or imprisonment of one to ten years; attempt to do business contrary to the act by fine of $100 to $5000, or not over ninety days in jail.

Only fifty out of 500 applicants have passed muster. The flagrant fakes simply, and silently, crossed the state line, one of them, which had reaped $400,000 in Kansas, going as far as Winnipeg. One brazen mining promoter is now behind the bars. A drain of over $6,000,000 cash a year has been stopped. Better 6,000 automobiles than reams of worthless engravings.

The postoffice, which is soon to report more concretely on the matter, has conservatively estimated that in the past decade credulous dupes nave been swindled out of a billion—thousands of shabby tragedies of shame, tears and blood. Bequests, insurance benefits, and lifetime savings have bnen scented and looted by the mining, oil, rubber, land, building and irrigation pirates. "Sucker" lists, running from 10,000 to 250,000 names, have been peddled at one to 25 cents a name, according to quality.

It is true that exposure has rubbed the bloom off this game. Over sixty such frauds have been stamped out by Uncle Sam. Access to the mails and to advertising columns is now less easy and more dangerous. The public itself is less ignorantly gullible.

But the postal raid can come only after much of the damage is done. The ounce of prevention must be furnished by the states that in the past have let their sovereign chartering powers to be so abused. Theft or misuse of the people's money by banks, insurance companies, etc., is guarded against; so should it be with these other, generically less dependable, creatures of the state. The stable door should be locked in time.

It is from this viewpoint that the newly convened legislature of Massacnusetts has been officially asked to consider such a statute remedy where none exists. No definite statistics are now available as to past plunderings in the frugal Bay State; but legislative inquiry supplemented by promised federal data, may fairly disclose the need of action that is believed by local investment authorites to exist.

At the recent convention of state bank commissioners in New Orleans the Kansas experiment aroused deep interest. As yet, the vultures need merely fly across state lines; were joint and uniform state policy adopted, broadly following the Kansas example, they could land nowhere. The sole criticism might be of the establishment of forty-eight dictators as to what "promised a fair return," should the full measure of Kansas stringency be accepted.

Were the states, however, to check, by publicity and supervision, the snatchings of these financial harpies, more than the salvage of an immense sum would follow. It would hasten the extinction of the credulous "get-rich-quick" belief in impossible income returns; and it would largely recruit the twin armies of savings depositors and of small stockholders in legitimate corporations.

It is a notorious fact that for years every city, town and hamlet in every state of the Union, has been infested with promoters and vendors of the shares of fake mining schemes and other fraudulent devices whereby vast sums of money have been drawn from unsuspecting and unsophisticated individuals of all classes, trades and professions, whose avarice or cupidity ever renders them an easy prey to the wiles of unscrupulous tricksters and "promotion thieves."

Boston, for many years having enjoyed the distinction of possessing the greatest market in the world for copper mine shares, it is but natural that the speculative fever which had led to the enrichment of so many of her prominent citizens, should permeate and finally infect the industrial and moral fabrics of the entire country. Their earlier investments, which were chiefly confined to the great copper mines of the Lake Superior region, proved to be immensely profitable; but it soon came to pass that there were not enough REAL MINES to provide investment opportunity for the

numerous small hoards of her thrifty and progressive citizens, who began to look upon the meagre increment derivable from the factory or farm as entirely too tardy to meet the requirements of a constantly expanding ambition.

At first, their appetites were appeased with small and carefully selected packages of beautifully gilded and embossed paper, labeled certificates of shares in the "Great Eureka," "Last Chance" or "Bunker Hill" copper, gold and silver mines

Of course, all mining shares looked alike to a people who were willing and eager to be made rich at the expense of the accommodating fakir, who seemed ever anxious to share his bounty at ridiculously low prices, so that there was always impatient haste to load up with the precious documents lest the supply should become exhausted before the constantly increasing demands could be satisfied. But to the bewildering astonishment of all, the sporadic adventure of the pioneer solicitor proved to be the advance courier of an army of "refined swindlers," each bearing bundles or bales of title deeds to a share in the "latest discovery," which always exceeded in richness and value all that preceded it. Finally, when all of the wants of the people had been supplied with these gilded evidences of wealth, in exchange for their surplus hoards, and they had sat down to await the coming of promised "dividends," NO DIVIDENDS came. Then it was that the "cost of living" arose to insuperable heights. But this was unimportant, because there were but few who could supply the price, had it remained ever so low. Then they cursed the "rich" and the frugal and thought "the thoughts of socialism and anarchy"—and thus you find them today. However, it now seems apparent, in the light of the News Bureau's comment, as quoted above, that in their sane moments, the people of Boston and of Massachusetts have determined to forstall a recurrence of the swindles that absorbed their substance and paralyzed the vital energies and industry of the state, by adopting the "Blue Sky law" of Kansas. Let us hope that the good resolution may not be forsaken and that every other state in the Union will "go and do likewise."

Such a law, had it been in force in this State ten years ago, would have saved the people of Utah MORE THAN TEN MILLIONS OF DOLLARS. And above all and of infinitely more value than preserved wealth—it would have prevented the deplorable degeneration of moral, mental and industrial energy which now glares from the sunken eyes of the thousands of victims of the ravages of accursed greed, fit and forced companions of socialism and anarchy.

Remembering the "Newhouse Mines" and the hundreds of other swindles of less magnitude but equal perfidy, perhaps our own Utah Legislature, when it shall again meet, will follow in the footsteps of our sister, Kansas, and preserve our people from the plundering schemes of these rapacious rogues.

o

"BAD LUCK" GUGGENHEIMS

At the risk of receiving another peremptory "stop" order from some of the Guggenheim offices, Mines and Methods goes back to the files of the Salt Lake Tribune of October 10, 1908, for the following recital of Guggenheim bad luck. It will be noted that it serves to emphasize all that Mines and Methods said on the subject in last month's issue.

Some unfortunate investments of the Guggenheim interests in the mining line are just coming to light and explain in a measure why there has been such a housecleaning in the field forces, for the purchase of these properties was largely upon the recommendation of the highest paid mining engineering talent in the country, says the Boston News Bureau.

The Guggenheim Exploration company which is the principal mine owner of the Guggenheim outfit, has expended a total of $27,000,000 in acquiring properties within a comparatively few years.

One of the leading mining assets of the company was the property at Valerdena, Mexico. This was a silver-lead group, and was operated privately for years by Barton Sewell and associates, known as the old American Smelting and Refining crowd. The property produced between $8,000,000 and $10,000,000 from the old silver-lead ground from carbonate ores. Then no zinc had appeared in the ores and smelting costs were exceedingly low, and it was possible at that time to derive excessively large profits in treatment of custom ores. The Sewell interests sold the properties to the Guggenheims for $6,000,000, and they expended $1,000,000 in a new furnace plant and $400,000 on a new power plant. At the same time they purchased a copper property sixteen miles distant, and built a railroad to connect it with the Valerdena plant, so that the total investment at this point amounted to not far from $10,000,000.

Soon after the Guggenheim control, however, arsenic came in the ores, and operating conditions changed so that it is now said there has not been a dollar of profit derived to date on this investment At the copper mine they went down 600 feet and found that the ore is practically exhausted, running at the lower levels but 1¾ per cent copper. Here is a $10,000,000 investment which could probably not be resold for over one-tenth of the cost. Valerdena is now a fighting word in the Guggenheim offices.

A second pronounced Guggenheim failure was a silver-lead property near Silverton, Colo., for which $2,500,000 was paid for the mine and an additional $750,000 expended in a new mill and equipment only to discover when the mill was ready that the mine was practically out of ore.

The Guggenheims likewise have a $7,000,000 investment in the Yukon, but the public was given an opportunity to help shoulder this burden. The selling of the shares was given to Lawson who was given an option upon 700,000 shares at $5 per share. The Yukon flotation some people call it by a harsher name resulted in 400,000 shares of the company being distributed to the public at from $6 to $8 a share. The distributor got his stock for $5 per share net, but as he had previous to the public offering distributed 200,000 shares among a favored few at 5½, he was obliged to take this stock back in the open market from $6 to $8, so that the net Lawson profit was ⅝ of a point on the [illegible] shares, or $270,000. The Guggenheims paid the advertising bill of about $[illegible], and received an acknowledgement in the shape of an immense bunch of Lawson pinks sent to the Mauretania when Daniel Guggenheim sailed for Europe, shortly after the Yukon flotation.

Another chapter could be written of the Guggenheim investment for the American Smelting Securities company of between $[illegible] and $10,000,000 in the three smelting plants on the Pacific coast. These included the Tacoma plant, for which $4,000,000 was paid, or many times the price at which the same plant had been offered to other interests six months previous to the time the Guggenheims purchased it. The Selby plant on San Francisco bay cost almost as much as the Tacoma plant. It is not now productive of earnings, because it it shut down tight, the agricultural interests having secured a permanent injunction against its operations because of the smelter fumes.

A third was the San Bruno plant, which was to have been built on San Francisco bay at a cost of $7,000,000, but was abandoned after the expenditure of $1,500,000 because of court injunctions from the agricultural interests.

o

Elsewhere in this issue will be found an article dealing with the financial methods of the Guggenheims which is reproduced from the January 6 issue of Collier's Weekly. It describes how the family of "smeltermen" worked the public in Federal Mining and Smelting and gives an intimation of what is likely to happen if things work out right in the Braden Copper scheme. The article is a good companion story to that published in the December issue of Mines and Methods, wherein it was shown how the famous family was beginning to feel the effects of drifting on to the shoals of greed and avarice where they had been steered by sublime faith in their own infallibility and advice of their engineers. They had used the public's millions to make millions for themselves and they hoped to gather a much greater harvest without letting the public in. When their predicament finally dawned upon them, it was too late to again secure a public following. The article from Collier's gives one of the reasons why. Mines and Methods expects to offer others in the near future.

o

The cut in the dividend of the Yukon Gold Company's dividend—from 2 per cent to 1½ per cent—is explained away by Mr. S. R. Guggenheim, who attributes the reduction to "the extraordinarily dull season prevailing in different parts of the world," and to the fact that two new dredges were not finished in time to be of much use. Glittering generalities don't go far towards soothing disappointed shareholders.—Canadian Mining Journal.

o

Crib coffer-dams can sometimes be made by building a crib and sinking it. For shallow water the crib is sometimes made of uprights framed into caps and sills and covered on the outside with tongued and grooved planks.

of the republic, but not miners and common labor."

Obviously, the Chilean laborer, though better sober than drunk, is at his best unorganized. These are matters all very interesting to capital, invited to embark itself in a strange land. Directly one reads: "The Government of Chile is a republic, stable and reliable, and no fear is felt regarding the safety of investments made by foreigners." That is most reassuring. All of these remarks tend to the following culmination:

"The monetary system is such as to favor the foreign investor, for the reason that he pays for his labor in depreciated currency, and sells his product on the gold standard. A law has been passed putting Chile on the gold basis, and this was to be operative on January 1, 1911, but it has been considered to the advantage of the large landowners to avoid the change, and hence it has been again postponed—probably to be continued. The proposed change would bring the Chilean peso to 18d sterling in value, whereas now its value is below 11d."

Seldom does one see a problem of division in the making.

There it is.

Guggenheim finance undertakes to exploit the mineral resources of Chile, not for Chile, but for finance. It will make the Chilean laborer sober (though he be proud and independent), not for his own sake, but for finance; it will keep him unorganized if possible. Lastly, it will strike hands with the large landowners of Chile to postpone the gold standard, in order that finance and the large landowners together may buy labor for a peso worth twenty-two cents and sell its fruits in a peso worth thirty-six cents.

The reason finance can exact always the larger division is that it is heartlessly intelligent. The Chilean laborer is proud and independent, but too unintelligent to know what is happening to him.

One can imagine that after the Chilean laborer has been kept sober in spite of himself, for the sake of finance, he will, after many years, begin to think. He will have the effrontery to demand a larger division. He may protest against receiving his wage in a depreciated currency, while the product of his labor is sold on the gold standard. Then finance, with its large investments in copper mines, railroads, and prerogatives, ably supported by the landowners, will call the Chilean laborer a Socialist and lecture him sternly on the sacred rights of property. He will hesitate and perhaps forbear, but not for long. He will be dissatisfied with the slight concessions received, and demand yet more whereupon finance and the large landowners will warn him solemnly and with sorrow, and purely for his own good, that if he persists in the way he is going all progress will stop, all property will perish, and Chile will become a wilderness. Perkinses, Garys, and Littletons will rise up to tell him that they love him and are for him, only he is unreasonable. Above all else, he must be reasonable and patient. They will pension him, they will make him more comfortable, they will raise his wages, and they will allow him to buy shares in their business and thereby share in the profits of capital, but he must be fair and desist from his Socialistic attacks upon capital.

It will then be 2012, perhaps, and finance, both foreign and Chilean, will have had time to incorporate companies and sell the shares thereof to the people of Chile, so that when the Chilean laborer has become intelligent enough really to know what is happening to him, he will perceive that the resources of Chile have been bought back from finance at a very high valuation by the investors of Chile. They would be greatly damaged by radical and progressive legislation and are all against it. After that it will be a compromise of Things As They Might Be with Things As They Are, and then the average Chilean will learn how to lose money in things like Federal Mining and Smelting common stock.

OTHERS ALSO HAVE BEEN TAUGHT.

The people of Chile have much experience to digest before they will be as intelligent as some of the casual-minded people who bought Federal Mining and Smelting shares in 1905 and 1906 under the delusion that they were getting into a fine Guggenheim speculation, and who, now that those shares have only a nominal uncertain value, have the consolation of learning from whom they did not buy them.

The Chilean laborer does not know what is happening to him in Braden Copper. Neither does the holder of Federal Mining and Smelting know exactly what has happened to him.

The Braden Copper Company is owned by the Braden Copper Mines Company, which is a holding concern controlled by the Guggenheim interests, according to "Stevens' Copper Handbook." But if anything untoward should happen to Braden Copper it might develop that the "Stevens' Copper Handbook" was as much of a word of fiction as the other works of statistical reference which have called Federal Mining and Smelting a Guggenheim proposition. The holding company is a wonderful devise!

NORTHWEST MINING MEETING

There is to be an important gathering of mining men at Spokane next month, the purpose of which is to discuss many subjects of grave importance to the mining industry. Unlike a session of the American Mining Congress, in which everything but the real things which affect mining is annually accorded so much valuable time of the delegates, this Spokane meeting promises to consider and discuss phases of the present situation that are calculated to encourage the industry and its development along lines that will safeguard investment and secure a greater co-operation among those actually engaged in the business.

This meeting is to be held under the auspices of the Mining Men's Club of Spokane, at the Spokane hotel, on the 15th, 16th and 17th of next month (February), and promoters of the gathering are making preparations to take care of not less than 1,000 people from the western mining states and British Columbia. Some of the subjects that will receive particular consideration are: The mining laws; leasing vs. freehold; mining in forests; mining investments; water power development; metallurgical economies; wastes and losses; the prospector; the miner; the promoter; the mine manager; the investor; safeguards of mining investments; mining development, and other subjects which the spirit of the gathering are sure to suggest and force to the front.

Elaborate plans of entertainment are being arranged by the club and everybody engaged in the business of mining and kindred pursuits—and particularly through the Pacific Northwest—who may attend, are promised a profitable and enjoyable time. Railroad rates of one and one third for the round trip are being arranged for, the Club's announcement on this subject reading. "Pay full fare going, demanding certificate from agent, to be presented to the convention secretary." Utah ought to be well represented.

"What is this new commission form of government that has been inaugurated here since I left the state?" inquired a mining engineer who has just returned from a two years' trip to South America. His old Salt Lake friend disgustedly replied: "O, that's something that the cat dragged in."

LEACHING APPLIED TO COPPER ORE*

Fourteenth Article Reviewings Results Accomplished, With Special Reference to Leaching Rock Without Mining

By W L. AUSTIN,†

It is immaterial whether or not a line be drawn between the extraction of copper from mine-waters which have been pumped, or allowed to flow from mines, in the ordinary course of events, and an operation comprising the artificial preparation of a copper deposit so as to facilitate oxidation and subsequent extraction of the metal. Both operations have been repeatedly carried out, and are practically identical in their nature, but the treatment of waters necessarily removed from mine-workings has been much the more common undertaking. The present article will deal primarily with the treatment of waters designedly passed through ore with a view to collecting the soluble copper salts therein contained, and the subsequent precipitation of the metal—in other words, with the artificial leaching of rock in place.

In a former article (Mines and Methods, Volume II, pages 153 and 187, there was described an experiment carried out upon a cupriferous deposit artificially prepared so that the ore had a chance to oxidize, water being let in afterwards to dissolve the soluble salts. It was explained in the said article how a deposit of porphyritic rock might be opened so as to expose a very large tonnage at comparatively small cost per ton of contained cupriferous material, and it is clear that once such a mine has been made ready for the water, the cost of producing copper will be confined to precipitation, with possibly the additional expense of pumping where it is necessary. Such a mine will yield copper for a long term of years from rock of a grade which it is not possible to mine under average conditions, and it will do this regardless of strikes, panics, or other disturbances of the usual kind.

When the experiment at Clifton was undertaken, it was not known to its projectors that there had been any previous work of a similar character; but since then a number of examples have been cited in the technical press, among which is one described by Philip Argall in Mining & Scientific Press of May 19th, 1906, pages 325-326.

Mr. Argall relates that at the Cronebane mines in Wicklow county, Ireland, the drainage was formerly run into a series of pits—each ten feet long, four feet wide, and eight feet deep. The sides of the pits were of masonry and the bottoms consisted of smooth flagstones. Rude wooden beams were laid across the pits upon which iron bars were placed to serve as precipitating metal. The iron bars were taken up frequently and the copper rubbed off them into the pits, so as to afford the waters better access to the iron. The bars were dissolved in about twelve months, when the iron was soft; but hard iron or steel were acted upon less rapidly.

When the iron in any particular pit had been sufficiently eaten away, the water was turned aside from that pit and the copper precipitate was shoveled out. One ton of iron (probably 2240 lb. was meant) is said to have produced 4424 lb. precipitate, and each ton of precipitate yielded 1792 lb. pure copper. On this basis one ton of iron was sufficient to produce 3539 lb. metallic copper, which is equivalent to a consumption of one pound of iron for each 1.6 lb. pure copper turned out. This copper brought in the market £10 more per ton than did copper resulting from ordinary ore-smelting operations. These figures, (presumably taken by Mr. Argall from the pages of the "Philosophical Transactions" whence the data was derived), do not agree with the usual statement that it reuqires from two to three pounds of iron to extract one pound of copper from mine waters. It is known, however, that with varying conditions the amount of iron consumed in the process of cementation differs widely, and as Mr. Argall had charge of the underground precipitation plant for a time, and therefore was familiar with the relative amounts of iron corroded and copper produced, it must be assumed that conditions at the Cronebane mine were out of the ordinary. The fact that pig-iron was used for precipitating purposes may have had something to do with the favorable result achieved, for the carbon present would form with both the iron and the copper galvanic couples, and it has been shown that such couples are very active in cementation. With proper apparatus, and the right adjustment of proportions of the elements composing the precipitant, it is not difficult to obtain results such as mentioned by Mr. Argall.

One of the improvements derived from experience at the Cronebane mine was settlement of the drainage in pits, only allowing the clear liquors to pass over the iron.

It was found in these precipitating operations that only a small quantity of the copper in solution was saved in the pits, and it is stated that these might be indefinitely extended without observing a sensible abatement in the copper content of the waters. The quantity of copper wasted at the property about the time referred to is thought to have been comparatively large, for in one stream alone the loss was estimated at 124,100 lb. per annum.

The handling of corrosive mine-waters has often been a problem with which those in charge of mines carrying sulphides in their ore have had to contend, the means employed at Wicklow to secure an efficient pumping apparatus are, therefore, of interest. Cornish pumps were used, the cast-iron water-columns of which were lined with quarter inch softwood staves. The flange-joints of the pipes were connected by gaskets of iron, one-and-a-half by quarter inch, around which was wrapped coarse flannel soaked in tar. The flannel and iron combined made a gasket about two inches thick, and in screwing up the pipe joints the tarred flannel was pressed out over the wood lining, securely sealing the iron pipe against contact with the acid waters, as well as making a tight joint between the pipes. Coarse tarred flannel, well painted with warm tar, was also wrapped around the pipes wherever these were exposed to dropping water. The suction pipes for these pumps consisted of logs of beach-wood, bored out to size, the bottoms being drilled with suitable holes to form strainers. The plungers and glands were made of bronze; the valves of copper and leather. These metals corroded, of course, and were about the only parts of the pumps which required frequent attention and occasional renewal.

By 1798 the copper content of the Cronebane mine drainage had fallen off materially, and low-grade pyritic ore was heap-roasted and subsequently

* Copyright, 1911, by Mines and Methods Publishing Company.

† Mining Engineer and Metallurgist, Riverside, California.

leached to increase the amount of copper salts in the drainage waters. Then came a period in which operations were suspended.

The workings were reopened in 1874, and the effluent waters were then found to carry merely a trace of copper, though the mine had been closed for twenty years. Ocher had accumulated in the drainage adits almost to the roof, and the stopes above water, and the vein exposures were almost completely sealed with ocherous deposits. Apparently the copper had gone, leaving the sulphides so coated with ferruginous matter that the waters and air did not have access to them, which would account for the lack of soluble copper salts. As soon as the stopes, drifts, and working faces had been cleaned, oxidation proceeded as before, and the effluent waters again became rich in copper.

On account of difficulties arising with an adjoining property, it was no longer feasible to treat the waters in an outside plant, so an underground system of precipitation was inaugurated. This, Mr. Argall states, was a great success, owing in part to the higher temperature of the water, in part to freedom from sediment and almost entire absence of ocher.

Immediately below the gossan of the Cronebane vein there was found a rather soft clay filling which carried an abundance of granular pyrite, and various other copper minerals including sulphate. These deposits were leached in place, by first driving numerous small drifts through them, and then turning water into the overlying loose gossan. This innovation soon formed an important part of the mining work. The copper-bearing solutions were allowed to flow into the different levels between the outcrop and the lower adit, and being forced to traverse some old stopes and fillings, were finally collected at the lower adit where the copper was precipitated from the liquors on pig-iron.

As experience was gained in the work the following leaching cycle was evolved: First, there was allowed a period for oxidation of the sulphides, followed by a second period permitting the salts formed to go into solution. A third period succeeded, in which the ferric oxide, (which had a tendency to seal up the sulphides and prevent further oxidation), was removed. The ground was divided into sections, some of which were oxidizing while others were leaching, constituting the first two periods of the cycle. The third period was occupied in running short drifts across the vein and allowing these to cave. At times stoping was resorted to, to afford room for the settling vein-matter. Sometimes the vein-matter was caved through to the gossan workings, and the caved material was employed to fill lower stopes where in due course it was again subjected to the leaching process. The methods used are said to have proven entirely satisfactory.

The Connorree mine which adjoined the Cronebane is said to have produced prior to 1872, $75,000 worth of copper annually. It was worked for a year or two almost entirely for the cement-copper obtained from drainage, and all the water was pumped from a depth of 540 feet, using expensive coal for power. This mine was closed in 1880, and in 1884 it is stated that the stagnant mine-water was found to contain forty grains of copper to the gallon. Taking the gallon at ten pounds, forty Troy grains would be equivalent to 1.14 lb. copper per ton of 2,000 lb. of water, which is close to the amount observed in other cases where mine-water has been permitted undisturbed to take up soluble copper salts. At one time the ore of this mine was kernel-roasted, and the oxidized envelopes of the sulphide kernels were leached in the mine water.

A precipitating plant was also erected at the Ballygahan mine which is on the same lode-series, and this plant is said to have been in profitable operation for five or six years. The pumping was done in this case with water-power. Some analyses made of the waters before and after precipitation gave following results:

In 100,000 Parts.

	Before Precipitation.	After Precipitation.
Ferrous oxide	81.81	94.75
Ferric oxide	4.30	6.70
Cupric oxide	9.32	1.91
Sulphuric acid	634.26	642.34
Manganese oxide	2.30	2.50
Zinc oxide	1.20	1.80

A content of 9.32 parts of CuO in 100,000 is equivalent to 0.00932 per cent, which corresponds to 0.00744 per cent Cu (0.1488 lb Cu per 2000 lb. solution), an amount of metal which approximates the average that mine water in motion appears disposed to take up under normal conditions.

It is stated that the water issuing from the Butte mines contains an average of 0.0025 per cent copper, and that 5,000,000 lb. of the metal are recovered from them annually (Engineering and Mining Journal, Vol. LXXXV, page 99); but the conditions there are somewhat unusual. The Butte mines are very extensively opened and were very hot, so that the waters traveled long distances through old workings (some of which are on fire) and had every opportunity to take up soluble copper salts. The drainage at the Anaconda mine is allowed to run from level to level through drill-holes until the pumps are reached. These drill-holes choke up with sediment and basic ferric salts and require re-drilling from time to time. An analysis of the water from one of the large Butte mines, made some time ago, gave the following results:

(Specific Gravity of Water=1.005.)

	Grams Per Liter.	Per Cent.
Copper	0.1226	0.0122
Iron in suspension	0.1274	0.01267
Iron in solution	0.0672	0.0067
Arsenic	0.00264	0.00026
Antimony	0.00088	0.000088
Free acid	0.1400	0.0139
Prob. combination.		
Bluestone ($CuSO_4 5H_2O$)	0.4830	0.0481
Ferric oxide (Fe_2O_3)	0.1820	0.0181
Ferric sulphate [$Fe_2(SO_4)_3$]	0.2399	0.0239
Arsenic	Undetermined	
Antimony	Undetermined	
Sulphuric acid (H_2SO_4)	0.1400	0.0139

In September, 1906, the flow for the month from one of the largest groups of Butte mines averaged 0.02 per cent copper; in December of the same year the average for the month was 0.04 per cent on a flow of 470 gallons per minute. In January, 1907, the same waters carried 0.16 per cent—the highest record, due to fire in the mine—and in February of that year the average for the month was 0.07.

Another instance of leaching unoxidized copper-ore in place is mentioned by Mr. H. T. Durant in Engineering and Mining Journal, November 11th, 1911, page 928. The name of the mine is not given, but it is said to be situated "barely 300 miles from London," and it is stated that the operation is upon a working scale and has been carried on day in and day out for over sixty years. The deposit is referred to as being a vein, which in places exceeded one hundred feet in width but elsewhere was so narrow as to render working unprofitable.

The underground workings are said to resemble a rabbit-warren, and the fact that the mine is thoroughly honeycombed accounts to a large extent for the ease and rapidity with which much of the copper passes into sulphate form.

The property is drained by an adit the mouth of which is closed by a dam, the latter fitted with a sluice valve. The operations consist in pumping the mine full of water, practically to the collar of the old main shaft, and then opening the valve at the adit mouth and allowing the liquors to flow to the precipitating plant. The latter consists of a number of shallow, rough, stone-lined pits, arranged in parallel series for convenience in cleaning and distributing solutions. These pits are filled with scrap-iron.

After precipitation of the copper, the liquors containing the iron derived from the ore, together with that corroded in the precipitation pits, are passed through a number of pits similar to those already

mentioned. These latter pits are also arranged in parallel series but are larger than the ones employed for cementation: in them the bulk of the iron is deposited through aeration and oxidation, and a good, marketable ocher is produced. This material brings in the market from twenty to thirty shillings per ton, according to quality.

After flowing through the ocher pits the water is more or less freed from iron and when required may be pumped back to the mine to repeat the same cycle of operations. The liquors flow by gravity from the adit mouth through the precipitating pits, and then through the ocher ponds, power being used only for pumping back to the mine.

The mine is filled with water from two to four times per annum, varying with the seasons. Only one skilled man is employed on the work, assisted by two or three laborers, the number of the latter being increased when the copper precipitate and ocher are cleaned up. The application of the described method of leaching was facilitated by the contour of the country, and by the unsystematic methods of exploitation used by the old miners. The further fact that much of the ore was left in place, either on account of narrowness of vein, or grade, or both, and the existence of large blocks of complex sulphide-ore containing small quantities of copper, made it feasible to leach this copper-sulphide ore in place.

The net result from the operation since the inception of this method of treatment is said to be about two hundred tons of metallic copper annually, and during the same period from 1500 to 2000 tons of ocher are produced The whole equipment is represented to be extremely crude, and the ingenuity displayed in securing such good working results with the means at hand commands admiration.

According to Mr. Morton Webber (Engineering and Mining Journal, (April 8th, 1911, page 700), at Rio Tinto, in Spain, water is led into the mines under certain conditions. The ore is mined in large galleries, and the honeycombed part of the "vein" produced by the removed chambers offers a large surface exposed to the action of the air and moisture, which in turn brings about oxidation of the copper in the ore to sulphate and other forms. The cupreous liquors naturally gravitate to the bottom of the mine from where they are pumped to the surface. They are then led into precipitating pits similar to those employed for treating cupreous solutions obtained more rapidly from ore which has been heap-roasted. The copper derived from mine drainage is such an important item at Rio Tinto, that the magnitude of the rains during the wet season is said to materially affect the years' profits.

Another case mentioned by Mr. Webber is that of the famous old Parys mine at Anglesey. For a long time water was pumped out of the mine and led into pits which were lined with brick and contained scrap-iron. The iron was raked over from time to time, and gradually the old pots, kettles, meat tins, shovels, etc., passed into solution while the copper was precipitating. The iron was not lost for the waste liquors from the precipitating pits were drawn off into large pools where the ferruginous salts gradually passed to a higher state of oxidation, depositing ocher. The ponds were run dry and cleared out periodically.

In a more recent communication Mr. Webber (Engineering and Mining Journal, July 29th, 1911, page 197) calls attention to an interesting example of the solubility of copper minerals under natural conditions as recently observed in the lower workings of a mine belonging to the Transvaal Copper Mining Company, at Cumpas, in the State of Sonora.

In September, 1910, after five years or more of submergence, the lower workings of the said mine were pumped out and resampled. The result of this sampling disclosed the fact that there was apparently no commercial ore left in this particular part of the mine. Previous samplings on different occasions by two independent engineers had indicated an average of over two per cent copper in this same ore. It being assumed that the different samplings were all carefully done, and that the findings were correct, then it would appear that the copper had been leached out in the interim between the earlier and later samplings, which view received confirmation from the interesting fact that the silver content of the ore in question was found to be the same after as before submergence.

In a criticism upon any novelty attaching to the idea of leaching ore without previously mining it, Mr. Channing in a contribution to Engineering and Mining Journal, March 25th, 1911, page 601, states that at the Eureka mine, in the Ducktown District of Tennessee, copper was extracted from rock in place as early as 1850.

Mr. Channing is right in contesting on a broad basis novelty in the practice of leaching rock "in place;" but there may be different methods of accomplishing a given purpose, one of which may be new. Besides, it is sometimes advisable to provide precautions against patents being issued to other parties who may be inclined to take advantage of a situation thereby created. Furthermore, circumstances may arise where those financing an enterprise demand that patent-protection be sought and obtained if possible. In any event, the systematic preparation of a large mass of low-grade cupriferous rock for leaching in-place is not such a common occurrence as to wholly exclude the projectors of the enterprise from claim to some originality of idea.

Mr. Channing states that at the time to which he refers, mining at Ducktown was confined entirely to the so-called black-copper ore, which was a product of secondary enrichment, lying just under the gossan and just over the unaltered sulphide. In most of the mines this black copper was from six to twelve feet thick and often carried as much as fifty per cent copper. At the Eureka mine, however, and also at the adjoining Isabella property, the zone of black copper ore was not much over a foot in tickness, and it was soon discovered that it would not pay to mine it.

The Eureka was provided with a shaft and several hundred feet of drifts along the black copper zone, and a method was finally evolved which consisted in permitting the mine to fill with water, then, after the water had been allowed to work on the ore for about a month, to pump it out again. By this means, it is stated, the black-copper was pretty thoroughly dissolved, and the metal could be precip-

(Grams per 100 cc. solution.)

Names of shafts	Free Sulphuric Acid	Ferrous Iron	Ferric Iron	Total Iron	Copper	Chlorine	Iron precipitated in Bottle	Alkalinity Equival'nt in Sulphuric Acid	Percent copper	Lb Cop. per ton Water	REMARKS
Diabase	0.261	0.0096	0.0031	0.0127	1.056	......	0.0048	......	0.1056	2.112	Strong green color to solution.
Old Ray	0.027	tr	.....	0.0021	......	......	......	......	.....	.....	......
Flux	0.1004	0.31	0.0990	0.4090	0.06	Pres.	......	......	0.006	0.12	Organic acid present.
Cittadini	0.126	0.392	0.03	0.422	0.152	......	......	......	0.152	0.304	Solution greenish.
Man Tiger	0.134	0.395	0.032	0.427	0.253	0.072	0.0313	......	0.0253	0.506	Solution clear.
Pearl Handle	0	0.1482	0.0072	0.1554	0.012	......	.....	0.0077	0.0012	0.024	Solution clear with brownish tinge.
Sharkey	0.019	0.5687	0.0397	0.6084	0.8378	......	......	......	0.08378	1.6756	Solution blue-green.
Collom	0.046	0.1682	0.0335	0.1917	0.476	......	0.01	......	0.0476	0.952	Solution with strong green color.
Rector	0	0.0254	0.0176	0.043	tr	......	.....	0.047	tr	tr	Solution dark with disagreeable odor.
Hecla	0	0.2249	0.0030	0.2279	0.0646	......	0.002	0.057	0.00646	0.1292	Solution colorless.
Mathias & Hall	0	0.0098	0.0155	0.0253	0.0474	......	.....	0.0067	0.00474	0.0948	Solution brownish.

itated from the solution by scrap-iron in the usual way.

When the mine was opened later it was found that the primary sulphides carried less than one per cent copper, which accounted for the thin deposit (one foot) of black ore referred to. The vein, or deposit, on the Eureka was wide, averaging at least 250 feet, and the gossan (aggregating approximately 500,000 tons) has all been mined, shipped, and smelted for iron.

The leaching power of ground-waters upon certain types of ore-deposits is illustrated by the analyses given in the table below. The analyses were made from waters taken from a number of old shafts on the Ray property in Arizona, and were furnished the writer by Mr. Philip Wiseman of Los Angeles.

The average copper content of these waters is 0.02689 per cent, which is ten times the average of the flow from the Butte mines as given in the Engineering and Mining Journal quoted from above.

At Bisbee, Arizona, 300 gallons of mine-water are pumped per minute from the Czar shaft, (Engineering and Mining Journal, October 31st, 1908, page 854), which is said to contain an average of ten grains of copper per gallon. The copper content of the water is, therefore, 0.0171 per cent. This water is passed over scrap-iron in a precipitating plant, the saving being in excess of ninety per cent. The precipitate shipped contains forty per cent moisture: the dried sample assays, copper 35%, silica 6%, iron 17%, aluminum 13% and sulphur 1.5%.

UTAH'S GOLD-SILVER OUTPUT

Increased production was made in all metals except zinc in Utah in 1911 according to V. C. Heikes, of the United States Geological Survey. The gold output was greater owing to the larger quantity of silicious ores mined in the Tintic district. Also of importance were the increases made at Bingham in the mining of low-grade copper ores, which carry only a few cents per ton in gold, but the aggregate of which is large. The total output of gold from the producing gold mines of Utah—the Mercur, Sevier, Susannah and Jennie, was less than in 1910. No new developments in deep mines were made that would tend to increase the future gold output, except in the Newton district, Beaver county, where some high-grade ore was encountered in rhyolitic rock, and at a property in Wayne county, which was equipped with a stamp mill. The placers on Green River yielded an increased quantity of gold. A dredge of the suction type with amalgamators was erected on Pahreah River, in Kane county, and is said to be operating and producing gold.

Silver production increased owing to the large tonnage of argentiferous lead concentrates and ore shipped, especially from Park City, where the output was greater than in any one of the last four years. In the Tintic district the yield of silver decreased owing to the reduced tonnage of lead ores, but this decrease was met by the increase in the mining of other ores, so that the total silver yield was not much less than in former years. According to early figures Utah ranked first in output of silver in 1911.

Fortunately for Utah mine operators, the facilities for treating ore and concentrates were ideal in 1911, and the lead-mine owners especially were provided with the best competitive smelting market that they have had for years. On the other hand, complaints were made by the lead smelters as to the small ore tonnage shipped, as only 40 to 65 per cent of their maximum capacity was in operation. Silver production under these conditions, of course, increased as every available ton of lead ore was mined and shipped. A part of this ore awaits the completion of the lead furnaces at Tooele. Nearly 7,000,000 tons of ore was mined in 1911 in Utah. Of this record-breaking output, about 5,850,000 tons was credited to the mines of the Bingham district. The greater part of this tonnage was low-grade copper-bearing porphyry ore mined from the Utah Copper and Ohio properties, and lead and copper ore from the mines of the United States Co. The two last-named companies increased their shipments of ore to such an extent that the roasting capacity of the lead smelters was overtaxed and they refused ores of high sulphur content in excess of contract agreements.

Beaver county mines yielded about 258,000 tons of ore, of which about 30,000 tons was crude ore and concentrates shipped from the Frisco, Star, and Newton districts. The new equipment at the Cactus mill was successful. The mill of the Horn Silver mine was closed, as a favorable contract was offered by the smelters. The Sheep Rock and Rob Roy mines near Beaver City, and the Susannah mine and part of the old dump of the Century mine, in Box Elder county, yielded gold bullion. Mines in Juab county produced approximately 246,000 tons of ore, of which the Centennial-Eureka mine, a gold-silver-copper producer, yielded about 117,000 tons, and the Iron Blossom about 60,000 tons of siliceous and lead ores. Other properties in Juab county from which shipments were increased are the Black Jack, Bullion Beck, Gemini, Golden Chain, Grand Central, May Day, Mammoth, Opohongo, Uncle Sam and Yankee. In the Fish Springs district the Utah mine produced rich silver-lead ore. The Park City mines were productive of about 300,000 tons of ore, against 215,339 tons in 1910. Part of this ore was concentrated, making about 65,000 tons of lead concentrates and 12,000 tons of zinc concentrates, both averaging well in silver. The crude ore shipped to smelters in 1911 contained silver and lead, and aggregated over 42,0000 tons, against 30,140 tons in 1910. From the Ophir, Rush Valley, and North Tintic districts, in Tooele county, 30,738 tons of lead ores were shipped from the Hidden Treasure, Cliff, and Honorine mines, and lead, zinc, and zinc-lead ores from the Scranton mines. In the Camp Floyd district, at Mercur, 250,000 tons of low-grade gold ore was treated by the cyanide process, yielding about $551,000 in gold.

According to preliminary figures compiled by the Director of the Mint, Utah produced in 1911, $4,709,747 in gold and 12,679,633 fine ounces of silver, valued at $6,973,798, against $4,312,700 in gold and 10,445,900 ounces of silver valued at $5,640,800, in 1910.

EVERYBODY'S EXPERT

O. R. Henney, who is a guest at the Linden hotel, this city, and booked to make this his headquarters for some time to come, is making a business of gathering reliable data concerning mines and prospects in this particular region. "My special mission," said Mr. Henney a few days ago, "is to secure information for small investors who have neither the time or means to get a correct idea of the value of their investments or speculations. I have had eleven years' experience in Colorado, New Mexico, Arizona, Southern Nevada and California, in addition to some time spent in Mexico and Honduras. Now I am gathering information and data for clients interested in the surrounding territory." If you want Henney's services, write to him at the address given above.

Geologists, sent to prospect in the Congo Free State the 970,000 square miles of land conceded as a mineral grant five years ago to a company in which Thomas F. Ryan is heavily interested, have reported that they have found large amounts of gold, iron, petroleum and diamonds. The finding of diamonds was a surprise. Two hundred and forty were found near Kambambay and some of them are on the way to America now.

cution. The mine is so laid out that the ore is delivered through a main gallery, at present on the 420-ft. level, to a large shaft of great capacity through which it is hoisted by compressed air engines and delivered directly to the mill.

THE MIAMI MILL.

The Miami system differs from that of most of the porphyry mines, in that the mill is built right by the shaft, the water being pumped to it, instead of carrying the ore a more or less distance to the water. The decision between carrying the ore to water and water to the ore depends, of course, upon the comparative expense. At Miani the cost of water is about 6 cents per ton of ore. Such a low figure is attainable only when there is economical use of water.

In laying out the Miami mill, so excellent advantage was taken of a rather difficult and forbidding topography that the result leaves but little to be desired. The ore passes from the bins in the headframe of the shaft to the crushing house, and thence by belt conveyor to the mill proper. In the latter the first crushing is done by Burch rolls, which are followed in some sections by chile mills and in others by Hardinge mills. Originally, one section was equipped with rigid rolls, but although they gave the commonly desired granularity of product, in this case they failed to release fully the mineral, for which crushing to pass a 60-mesh screen seems to be necessary. As between the chile and Hardinge mills, it is rather strongly indicated that the latter will become the favorite.

The pulp is washed on Deister tables. The concentrates run through a tunnel to bins at the foot of the hill. The tailings go to a dewatering plant below the mill, which operates with marvelous efficiency. The total quantity of water required in milling a ton of ore is nine tons; the quantity of new water supplied is only two tons. The dewatered tailings are discharged into a commodious pond formed by a dam across a small ravine. As discharged into it their copper content is not high.

The ore delivered to the mill has been averaging about 2.5 per cent copper. The ratio of concentration has been 20:1 to 22:1, the concentrates assaying about 40 per cent copper. The extraction of copper has been about 75 per cent. In spite of the fine grinding to which the ore must be subjected, the loss of copper in slime is low. It is expected that the extraction in milling will eventually be raised to nearly 80 per cent. Considering the character of the ore and the excellence of the mill equipment, it is not improbable that such a remarkably high extraction will eventually be obtained when it has been learned how to operate the mill to the best advantage.

DESIGN AND CONSTRUCTION.

In the matters of design and building, the Miami mill is at the present time the last word in mill construction. There is no other concentrating mill of which I am aware that has so much purely structural excellence, so much floor space, so much lighting (both by day and by night-, so unobstructing a belt, shafting and launder plan and so much cleanliness. Here is a mill in which a visitor may go in his best clothes without fear of harming them.

Some criticisms have been directed toward the Miami engineers upon the ground of their apparent extravagance. I use the word "apparent" advisedly, the cost of the Miami mill per ton of annual capacity not having been excessive even when compared to other mills of decidedly inferior construction. But even if some apparently unnecessary outlays were made in the Miami mill, I am, nevertheless, of the opiinon that the money was extremely well spent. An addition of 25 cents per ton of annual capacity in the first cost, let us say, is very quickly offset by the ability to extract an extra percentage of copper from the ore. This has already been demonstrated in the phenomenally high extraction that has already been made in the Miami mill. The provision of a commodious, well constructed and well kept plant improves the morale of the men. Given such a plant they are likely to adapt themselves to its' conception, whereas if put to work in an inconvenient sloppy plant, they are more likely to absorb the spirit of the engineers and themselves become careless.

The Miami mill has been compared to a magnificent mansion, fitted up with appropriate furniture. If, at any time, it may be desirable, it is an easy matter to change the furniture. In the Miami mill the furniture is the machinery and special apparatus. If, at any time, it may be necessary to change the machinery because of alterations in the milling qualities of the ore, or because improvements in the art have led to the development of better forms of machinery, adaptation to either condition is easy in the Miami mill, because of the foresight and broad conception of its engineers. From this point of view the elaborate construction of this mill is not only a direct means of immediately making more money, but also is an insurance against adverse alterations in conditions in the future.

INSPIRATION COPPER CO.

Going westward from the Miami, the orebody spreads out, or at least becomes less thick than it is in the Miami, and deflects to the southwest, the general trend being shown in the accompanying map. The orebody is faulted in the Inspiration property, as may be surmised from the peculiar shape shown by the map. Toward the Keystone line the orebody is broken by a fault that has thrown it down in the Inspiration territory and produced an area on the dip of the fault wherein no ore is to be expected. Another fault is known to exist in the neighborhood of the line between the Keystone and Live Oak property. Besides a vertical dislocation at this place, there also appears to have been a heave of the Live Oak orebody to the northwest. The faulting of this district and perhaps other geological conditions have not yet been adequately studied.

Up to the present time the work of the Inspiration Copper Co. has been confined chiefly to prospecting development, which has been both by churn drilling and by underground work, chiefly the former. A good deal of underground work has been done, but nowhere near to the same extent as was done by the Miami Copper Company.

The developments in the Inspiration have disclosed the existence of an orebody of about 120 ft. average thickness, with a maximum length of about 3,800 ft. and maximum width of about 1,600 ft. It is estimated that this orebody contains about 30,000,000 tons of ore, averaging 1.95 per cent copper.

The Inspiration is undoubtedly a very valuable mine, but in comparison with the Miami it is at the disadvantage of a materially lower grade of ore. It follows from this that if the extraction of the ore were to be conducted by the same methods as in the Miami mine, the cost per pound of copper product would be very materially higher. It is likely, however, that the mining of the Inspiration ore will be done by a cheaper method of caving, perhaps by suitable modifications of the methods employed at Bingham and at Ray. This will afford much cheaper ore at the expense of a lower percentage of extraction. I am, however, favorably disposed toward such systems when introduced under suitable conditions, and believe it to be not unreasonable to expect that the extraction of ore may be as high as 83 per cent. Any such result would, of course, go a long way toward offsetting the disadvantage of the lower grade ore. However, it is not to be expected, not even under the most favorable combination of circumstances, that Inspiration can produce a pound of copper so cheaply as Miami.

A considerable part of the Inspiration orebody is so situated that it can be extracted through an adit level. Just what use will be made of that entry, and, indeed, just what will be the plan for the mining and milling of the Inspiration ore, has not yet, so far as I am aware, been finally decided.

THE KEYSTONE PROPERTY.

Adjoining the Inspiration on the west is the property of the New Keystone Copper Co., which is an interest of the General Development Co. The surface of the country is noteworthy at this place for a remarkable coloration of the country rock by silicate of copper. Unfortunately the copper content of the surface exposures is not sufficiently high to be commercially valuable. The lines of the Keystone property proved to have been laid out in such a way that this company did not secure a large portion of the orebody.

As in the case of the Miami, the development of the Keystone mine has been chiefly by drifts, winzes and raises. It is only recently that any drilling has been done. The underground work was laid out in a thoroughly systematic way, upon two levels, viz: The 150-ft. and 250-ft. This work has disclosed an orebody about 400 ft. in width and 70 ft. in thickness. At the date of the last annual report of the company, last summer, it was estimated that 2,000,000 tons of ore, averaging 2.25 per cent coper, had been substantially prepared for mining. This ore is in the part of the property adjacent to the Inspiration. In going toward the west the Keystone ore dips downward, wherefore the drifts of the 150-ft level and then of the 250 ft. level pass out of the ore into the oxidized capping.

A winze put down from the 250 ft. level to the west of the line beyond which the ore had dipped below that level rediscovered the ore and gave a more correct understanding of its position than was possessed when the earlier work was done on the 250-ft. level. Inasmuch as the sinking of winzes is relatively expensive, recent exploratory work has been confined to putting down churn-drill holes from the surface at the corners of 100 ft. blocks. These have been proving the western continuation of the orebody, but its amount and grade have not yet been estimated. Near the Live Oak line the fault, previously mentioned, may cut off some of the ore, but probably to no great extent. It is reasonably to be expected that about 1,500,000 tons of ore will be added to the Keystone reserves, making a total of about 3,500,000, which may be somewhat increased if the basis of estimating be reduced to 2 per cent copper.

The Keystone mine is favorably situated for operation. The ore seems to grade off into the capping and a high percentage of extraction can perhaps advisably be effected by taking in a litt'e of the capping at the expense of a slight diminishing of the average copper content of the product. The shaft is adequate in size for the extraction of 350,000 tons of ore per annum and from the present outlook the whole orebody can be commanded from the 350-ft. level. The Keystone mine has not sufficient ore to justify the erection of a modern mill, and its ore will probably be treated in a section of the Miami mill that may be added for this purpose. The Miami mill is in view from the Keystone shaft, about 8,000 ft. distant and about 350 ft. lower, wherefore the ore may easily be delivered by aerial tramway, right of-way for which over the Inspiration ground is possessed. The Keystone mine is under the same management as the Miami.

LIVE OAK.

The Live Oak is the most recently developed of the mines of the Miami district, and the work in it up to date has been chiefly prospecting by drilling, although considerable underground work has also been done. A great deal more of the latter will be necessary in order to prepare the ore for mining, in which respect this property is more backward than either the Inspiration or Keystone.

In the Live Oak area the orebody pitches rather sharply to the west and in the western part it lies at a depth of about 800 ft. According to the estimates of the Live Oak engineers, they have developed 15,000,000 tons of ore averaging 2.1 per cent copper.

GENERAL OBSERVATIONS.

So far as known, the Miami district has only one orebody, disregarding its local separation by faulting. This is situated in the flank of the mountain rising from the northern side of "Miami wash," which is a branch of Pinal Creek. This mountain is cut by transverse ravines and valleys, producing a rough and irregular topography. The Arizona Eastern Ry. Co. extended its line from Globe along Pinal Creek, 10 miles to the town of Miami, above which the Miami mine is situated. The power plant of the Miami Copper Co. is at the foot of the mountain, at the terminus of the railway. The concentrates loading bins are near-by. Timber and supplies for the mine and mill are elevated to the mine by an inclined railway. The water supply for the mill is obtained from the Old Dominion mine at Globe, whence it is conveyed by pipe line, by gravity, to Burch. From Burch it is pumped to a tank above the mill, the distance being about four miles and the lift about 575 feet.

There does not seem to be any chance that the Miami-Inspiration-Keystone-Live Oak orebody will extend into any other property, except perhaps at the western end, and its existence adds no values to other properties to the north and south in the district beyond creating the hope that a similar orebody may be found. Prospecting up to the present time has given no support to such a hope. As to the western extension there is a suspicion that another fault has dislocated the orebody, and that beyond the Live Oak it is perhaps to be looked for to the north of what would otherwise be the line.

The Miami-Inspiration-Keystone-Live Oak orebody has now been rather closely delimtied, but all of the companies will probably add somewhat to their reserves. In this respect the chances of the Miami Copper Co. are perhaps the best.

It is not to be doubted that a consolidation of the four adjoining mines would be of economic advantage. By agreement they have adopted the sideline principle, wherefore no litigation is to be expected, but under individual ownership there will be troublesome mining problems along joint boundaries. There would be economy in capital outlay by concentrating the milling in one plant and there would also be economy in operation. Finally, there would probably be economy in smelting the concentrates. At present the Miami product is shipped to distant Cananea. A better

contract was made there than could be made at Globe, only ten miles distant. It would seem, however, that the concentrates of the Miami district ought to be smelted at home.

FUTURE OF CONCENTRATION

By M. P. BOSS.*

Following the introduction of the Frue vanner the public held complacently the thought that that machine would do about all that could be done in concentration. The years that have elapsed since have unveiled additional complexities in proportion as understanding has increased. Sizing and classification have long been in a measure appreciated, but even today are broadening into wider and more universal practice, and are evidently destined to much greater consideration by the general public. It has been and is customary to measure success by profits of treatment, quality of work often being sacrificed for quantity; and often the loss is a final and permanent one. This matter may yet run counter to the conservation tendecy, and thus stimulate a desire to get all that mechanical genius can get—to get out by automatic mechanical means what can now be gotten out by a batea through skillful hand manipulation. At the present stage of the art little progress can be expected by haphazard means. A thorough understanding of the principles involved in the obstacles that yet so thwart engineers is essential to cope with today's problems. This is particularly true in slime treatment. New devices bring hopes, to be followed by disappointments, yet the why and how is continually becoming better understood.

In all concentration two active agents are involved, impellant energy and retardation. Retardation may be liquid and non-directing, or it may be rigid and guiding. In a feed composed of true spheres of absolutely equal size, a concentrate could undoubtedly be completely segregated from a gangue of but little less specific gravity, even if the material was so fine as to be classed as slime, by machines now on the market. In true spheres 'impellant energy' (as of gravity) is in ratio as the cubes of their diameters mutiplied by their specific gravity, while 'liquid retardation' (as in precipitation) is in ratio as the squares of their diameters. This unfailing law is the bogey that is the cause of the greatest troubles in intelligently manipulated concentration. Two spheres of equal size but of unequal specific gravity would meet, in liquid precipitation, equal resistance, their displacement being the same, while the 'impellant energy' would be greater in the heavier sphere. Thus a large grain of gangue will sink faster than a small grain of concentrate. This is a clear reason why thorough sizing is desirable. The closer the sizing, the easier and better the dressing. It is easy to size a coarse material, but the difficulty multiplies with fineness, and in slimes one particle may be several times the diameter of another, an associated particle. From this rises the difficulty with slimes, a difficulty which probably never can be wholly overcome, so that there is little hope of slime treatment through 'liquid retardation' (precipitation or longitudinal hurling).

Rigid and guiding retardation, as on a table, or in a batea, introduces other principles, the horizontal plane estopping precipitation and the finer particles finding their way through the interstices between the larger grains and resting upon the bottom, where they are in a measure protected and are less affected by currents that sweep along the coarser grains. The efficiency of this decreases with depth of material and is a factor of grain diameter. The bed should be thinnest with slime, as a thick bed brings into play the 'liquid retardation' law, that precipitates the larger grains of gangue faster than the fine grains of concentrate. These are principles to consider in regard to riffles and to table-deck treatment, to avoid as much as possible ill effects from liquid retardation. When a concentrate particle has once reached bottom all effort should be made to keep it there. To this end riffles should be so designed as not to have a turbulent raising effect below them, unless material is very closely sized or of widely differing specific gravity.

The foregoing implies that all unencased concentrate material might be segregated from a gangue, even if only slightly heavier, when properly classified. The term classified, rather than sized, is used here advisedly. Material can be thoroughly sized by screens only. Classified is a broader term and includes hydraulic classification, which is a process based on the law of liquid retardation, wherein the heavier particles are smaller than those that are of lighter specific gravity. As we have seen, the latter is more suited to lateral table-deck treatment and the former to liquid retardation. In looking at the acres of concentrating machines in one of the great modern plants of today and realizing that the same machines are greatly overworked for commercial reasons, one quite naturally drops into computing the percentages of the total area that is actually segregating concentrate from gangue, and it is small.

From the present viewpoint, where is the relief? As has been noted, no space is wasted. Yet it is quite probable that in some future day more work will be done on a less area. About as the flying machine was to human travel a half dozen years ago, so centrifugal concentration is viewed today. Yet an impellant energy many times augmenting that of gravity may be developed by high centrifugal action, some like characteristic existing in both, yet with complications abounding for future solutions. When the capacity of present machines has been greatly increased without increase of cost, then a better quality of work may be expected. While very great progress will likely be made in the near years to come, there will likely be ample field for study for many years.

* In Mining and Scientific Press, January, 1912.

BILL AND THE "SUPE"

Now listen to me, while I tells to you,
The tale of the Supe an' Bill McGrue.

Bill he was takin' a little mope
After drillin' his holes in the stuffy stope,

An' settin' down on a timber car
He lights a match to a bum cigar.

He scarcely more than gits a light
When a guy in overalls heaves in sight.

"Takin' a rest?" says he to Bill.
"You bet," says William, an sets right still.

"Aint you got nothin' at all to do?"
"I have," says Bill, "when Im ready to."

"What would you do?" says the stranger guy,
"If the shift boss happened to wander by?"

"I'd sit," says Bill, "like a tired bloke,
An' take my time for my rest an' smoke."

"Do you know," says the stranger, "who I am?"
"I don't, says William, "nor care a damn!"

"Well, I am the Superintenaent here!"
Bill's grin extended from ear to ear.
"The Supe" he says, "of the hull big mine?
Thats bully," he says, "that's grand, that's fine;

A mighty good job fer a man to git
If I was you I would tend to it!"

Then Bill leans back on tne empty car
An' goes on smokin' his bum cigar.

Benton Braby in New York Times.

Water softening, where the hardness is due to lime sulphate, may be accomplished by the addition of barium carbonate. Barium sulphate is produced and lime carbonate forms, both of which are nearly insoluble, and will precipitate. Barium hydrate may also be employed, which has the advantage of decomposing the lime salt with the formation of CaO, which will reduce the soluble lime bicarbonate to the insoluble carbonate. The high cost of barium salts is an obstacle to its wide use for this purpose.

rich stores of high-grade that had been accumulated by the "office."

But this condition of affairs could not long abide, for mining at Goldfield was soon to be reduced to a different method, within the full confines of the law. The high-graders had become emboldened, and were drunk with their success, a success which lavishly afforded them means for the more common forms of intoxication. Many boasted and gloated over the measure of their prowess and spent their questionably acquired wealth on games of cards and in the giddy dances and dissipations of the halls and places of indulgence.

A HIGH-GRADE HERO.

One night a bold, burly and begrimed miner stepped up to a crowded bar in a saloon that covered half a block in Goldfield and which was crowded to every wall with a conglomeration of men. There, amidst the clouds of tobacco smoke and maudlin merriment, and clink of coin and glasses, and glare of lights, he thundered:

"Come on, COME ON, you high-graders and promoters and sons of guns—come all of you and have a drink on me. I am a high-grader out at the Mohawk mine and I've got the money, you bet!'

He clapped his handfuls of gold upon the bar, until all were at attention and drank of the firey beverages.

"Drink her down, boys; drink her down," he said. "There's plenty more where this comes from—plenty more—yes, damn it, there's plenty more. Have another drink, everybody! It's free. If you won't drink on me, then drink on this money, and we'll call it on Wingfield, the owner of the mine. But I'm a high-grader and I don't care who knows it; and, damn it, more than half of you are high-graders, you sons of guns. Come on now and have ANOTHER drink, and I'll say its on the whole darned camp."

ZENITH OF THE BOOM.

And so they drank and drank. If there were some that might not have money of their own, it was certain that most had, and the man who had not could live on whiskey. They were soaked with it—sodden with it—drinking and friendly or fighting and scheming, speculating and selling. The stock exchange was in a frenzied boom. The town was building with solid structures, and some establishments costing as high as a quarter of a million were being rushed to completion. Women and men lavished in luxury and finery, for money was flowing in through stock investments from all parts of the world, and the mines, worked by leasers and otherwise were actually producing millions. Just how much Goldfield did produce at this period will never be known, for the legitimate mint records of millions must be admitted to be meagre, because of all the stolen high-grade that went out by devious ways. Automobiles were thicker than farm wagons at a country celebration on the Fourth of July. The days of "plush and velvet," and of champagne and stock certificates and fat incomes on sales of shares, and of typewriters and boosting methods, were at their zenith. The hills and desert valleys resounded to blasts constantly tearing up the earth in and around the desert city.

HALT IS CALLED.

Money was changing hands almost by tons in games of chance; fortunes were changing hands in investments, and a giddy, lurid glare of dissipation and dance hall mirth made the days and nights pass like a drifting haze of dreams.

But the scene was destined to change. Myriads of investors who had lavished their money, often alike on good and bad securities had now begun calling for dividends or rather, more dividends. "What is the matter with the mines?" said the awakening investor. "What is becoming of our legitimate portion of the ores?" said the owners of the claims. "We will curtail the leases," said they. "We will develop and mine our own property under a more direct management. The leasing system as it has existed, is inadequate. Let us call a halt and have a clear and legal adjustment of our rights. We must and will be protected by law in the handling of our property as we choose. Organization is rampant among the workers. No longer limited to legitimate purposes, unionism is becoming a hold-up system, in which the desires and demands of an unlawful element is uppermost. They would secure to themselves, not only high wages, but also a privilege to help themselves constantly to the property of others. Let us, the property owners, demand and enforce our rights under the laws of the United States."

Then, indeed, there were rumblings and sounds other than those of merriment and industry in the mines. A considerable portion of the population was obstinate and loth to part with its illegal privileges, and profitable pilfering of the golden high-grade ores. While the inevitable change was slowly being wrought, came the nation-wide financial crash of 1907. Capitalists were planning, the populace was complaining, labor was combining and the more radical element was in control. Whatever the differing interests and demands, it was realized that established order and recognized laws must prevail. United States troops were sent to the scene, and though but few fatalities resulted at any time, it was apparent that the materials were there for combustion. The self interests of men on opposite sides had been aroused by the presence of gold—gold which most would get in any manner possible, if they could not get it by law or sufferance.

But the claim-owners, of course, were acting under established law and custom. No one could expect them to do other than act in accordance with their property rights. The Nevada State police provision, for some hundreds of armed men, came into existence and the U. S. troops, being withdrawn, the famous Goldfield properties were now to appear upon a new basis, in which capital would be protected in mining its properties in systematic, business-like and substantial way in which the profits above costs, under a free choice of labor would go only into the pockets of those having legal and rightful control.

UNDER THE NEW ORDER OF THINGS.

After some variations and smouldering revivals of the speculative spirit, we find Goldfield today progressing steadily and destined to progress as a great mining camp whose proven ores are largely owned by gigantic companies considerate of the normal needs and requirements of their employes—more generous, no doubt, than would be the "poor and honest high-graders," if they owned the same properties—for we are still at a hazy distance from that point in human progress that has been fancied by some when anything like a fabulously rich gold mine will be free to everybody.

It is a fact that the "poor and honest man" can no longer help himself to high-grade in the desert bonanzas; neither does stock in a thousand-and-one different properties from "Dan to Bersheba," sell as readily as it did in the good old days of the speculative period, when any prospect upon the deserts had more or less of a financial standing.

However, it has been demonstrated of Tonopah and Goldfield and several other of the new camps of the desert, that they are well up with the world's best mining propositions. Nevada, as a matter of fact, is one of the best mining regions in the entire world, and it is also evident that with all the scores of thousands who whirled through the lurid drama of the boom, its soil and treasure resources are practically unscratched and intact.

it flows without transportation of matter: when an electric current passes through a conductor of the second class there is always a transportation of matter, and usually chemical transformations are brought about.

Formerly it was thought that the electric current in passing through a copper sulphate electrolyte broke up the copper salt into two parts—(1) copper, and (2) a combination of sulphur and oxygen (SO_4). Such an hypothesis was quite natural, because metallic copper made its appearance on the cathode, and sulphuric acid accumulated in the liquor. Still several phenomena were observed which this theory could not satisfactorily explain. A closer study of the subject resulted in the development of the modern theory of ionization, a knowledge of which is essential in trying to explain reactions taking place when cupriferous liquors are subjected to electrolysis.

IONIZATION THEORY.

In refining crude-copper, inasmuch as copper is deposited at the cathode in the metallic state, and the metal composing the anode gradually goes into solution as sulphate, thereby maintaining the copper-sulphate strength of the liquor, the observed facts appear to explain the phenomena in the manner stated above; but at the same time it would seem reasonable to suppose that in the beginning of the operation a considerable force would be required to separate the metal from its associated acid-radical. Such, however, was found not to be the case—at least as far as concerned the work done by the current. Experimentation disclosed the fact that the smallest observable difference of potential between the electrodes of a copper voltmeter sufficed for transmission of current with the accompanying phenomena. In other words, it was found that an electrolyte would transmit a current without the latter exerting an appropriate force, such as would be necessary to tear apart a strong chemical combination. This interesting fact introduces the question as to the manner in which an electrolyte transmits the electric current.

When sugar, salt, and many other substances are thrown into water, they disappear as such, and it is said they are dissolved. They can be readily recovered by evaporating the water, but it is evident that when in the dissolved state their prior conditon must have been temporarily altered. If it were known, therefore, what happens to salt (NaCl) when it dissolves, then an explanation might be forthcoming as to why pure water is an extremely bad electrolyte, yet water with salt in it is a fairly good conductor.

The above mentioned, and other observed facts, led Arrhenius to formulate the hypothesis that all solutions of salts which are conductors of the electric current no longer contain the said salts in their original status, but that these salts are broken up to a greater or lesser extent (electrically dissociated) by the act of solution. The extremely small particles into which such salts are resolved in an electrolyte are termed ions. They are considered to be smaller than the old chemical molecules and atoms which before their advent did service in explaining chemical and physical phenomena. In addition to being a separate entity, each ion is thought to be combined with a definite quantity of electricity. It is not proposed here to enter into a discussion of the modern theory of solvation; nor to consider the ultimate composition of matter: attention will be directed only to such observed facts, and theories, as have a direct bearing upon practical electrolysis.

It is, at first thought, a severe tax upon the imagination to accept the idea that in dissolving common table-salt in water the liquid no longer contains the said salt in the form in which it was known to exist the moment before solution: that the salt in dissolving splits up for the greater part into sodium ions and chlorine ions, two of the most energetic chemical elements known to exist. A further difficulty presents itself in trying to imagine these substances as existing side by side in solution without their entering into combination with the elements of the water or with each other, and it becomes necessary in explaining the phenomenon, to advance the additional hypothesis that each elementary ion is itself combined with something which temporarily neutralizes its affinity for other chemical bodies. It is therefore assumed in the case at point that each sodium ion is combined with a charge of positive electricity, and that each chlorine ion is similarly combined with a charge of negative electricity. The electric charge combined with any ion, of whatever element, is assumed to be equal to that combined with each of the other separate ions, and as the sum of the positive electric charges must be equal to that of the negative, this is offered as an explanation of the fact that the solution remains electrically neutral. In the case of copper sulphate, the copper ions (cathions) are combined with charges of positive electricity; the SO_4-ions (anions) with charges of negative electricity.

WHY AN ELECTROLYTE CONDUCTS CURRENT.

With the help of the above mentioned hypothesis, it is possible to suggest a tentative explanation of the manner in which an electric current obtains passage through an electrolyte. Granting the presence of small particles of elementary, or combined substances, in a solution, which particles are associated with charges of electricity of opposite sign and are free to move in any direction, it is easy to understand that if two electrodes are introduced into such a solution—the one connected with a source of positive electricity, and the other with negative—that then the negative ions will be attracted to the positive electrode, and the ions combined with positive charges will move towards the negative electrode. Naturally also all the ions present in the solution will be set in motion as soon as there is the least electrostatic attraction offered by the two electrodes, and this explains why a current can pass through an electrolyte even when the electromotive force would have been insufficient to disrupt the combination of elements present in the salt before solution—the current simply attracts or repels the particles already dissociated by the act of solution.

Upon the arrival of the ions at the electrodes to which they are attracted, their charges are neutralized, and the ions themselves, deprived of their associated electricity, are free to unite to form molecules. Such is the hypothesis advanced by the foremost physicists of the day in accounting for the fact that when a solution of copper sulphate is introduced into a circuit through which an electric current is passing, metallic copper appears on the cathode plate and sulphuric acid collects around the anode.

However, a current passing through an electrolyte not only acts on the ions into which any particular salt—copper sulphate for instance—has been resolved, but it affects the ions produced by solution of other salts which may be present. No distinction is made by the current between the SO_4-ions originating in the solution of copper sulphate, and the SO_4-ions derived from sodium sulphate, sulphuric acid, or any other source. The same with metallic cathions—copper, sodium, etc. It follows that in electrolyzing a liquid containing substances other than those which are the object of the operation, where insoluble anodes are used, much of the current may be uselessly applied to production of hydrogen through the decomposition of water by metallic sodium deposited on the cathode when sodium sulphate happens to be present. The sodium hydrate thus formed naturally recombines with sulphuric acid produced at the anode, and the cycle recommences, unless the anode liquor (anolyte) is prevented from mixing with cathode liquor (catholyte) by introducing a screen (diaphragm).

Furthermore, chemical compounds produced in an impure electrolyte by the

LEACHING APPLIED TO COPPER ORE* (XXI)

COST OF ELECTROLYTIC EXTRACTION OF COPPER FROM ITS ORE (CONTINUED)

By W. L. AUSTIN.†

An example of the application of ferric chloride as a chlorine conveyor in the lixiviation of copper ore is found in the Baker-Smith process, described in U. S. patent No. 843,086, dated Feb. 12th, 1907. The characteristic features of this leaching method are: the bringing of fresh chlorine into contact with the ore continuously during lixiviation, and its adaptability to unroasted material. It differs from other processes employing ferric chloride as lixiviant, (wherein a batch of ore is treated with a solution which is constantly diminishing in strength), by the method of continuously applying fresh chlorine. Naturally, unless the strength of a lixiviant is maintained toward the end of the operation the solvent action must be weakened. In the Baker-Smith process a strong solution of ferric chloride is agitated with ore, and as fast as it is reduced to ferrous chloride it is withdrawn from the vat and recharged with chlorine. The advantage of such a mode of procedure is that one is working with a strong lixiviant up to the time that extraction of the metal has been completed. By this method the chlorine is continuously raising ferrous chloride to ferric, and in consequence that powerful reagent is only transferred to those substances which reduce ferric chloride, such as metallic sulphides. The presence of much ferrous chloride prevents the escape of chlorine gas, and it is not wasted by entering into useless combinations.

Metallic sulphides are attacked by ferric chloride, the metal going into solution and sulphur being liberated. If chlorine were applied direct to the ore, the chlorine would combine with separated sulphur, forming chlorides of sulphur which would consume the reagent to no purpose. Sulphur chlorides are decomposed by water, yielding hydrochloric acid, sulphurous acid, and sulphur. This is avoided in the Baker-Smith process by [illegible] the leaching apparatus. Sulphur separated from the ore by [illegible] sulphide [illegible] chlorides of [illegible]

[illegible]

sodium, calcium and magnesium are not desired in the lixiviant as they are said to interfere with the recovery of any zinc the ore may contain. The inventors of the process are ambitious, for they aim to recover copper, lead, zinc, manganese, silver, gold, and sulphur from mixed sulphide ore.

A lixiviant of from 1.2 to 1.5 specific gravity, containing two grams metallic iron per litre, is recommended by Baker and Smith, and the pulp is heated by live steam. The ore is ground and put through screens ranging from 16 to 40 meshes to the linear inch. The patent specifications are very full and show that much thought has been bestowed on the subject. The theory involved in the process is sound; but it would seem as though the apparatus advocated, and the mechanical manipulation suggested in the specifications, might be improved.

Applying the Baker-Smith process to ore containing: copper, 2.76 percent; silica, 46.0%; alumina, 8.2%; iron, 12.4%; calcium oxide, 4.7%; and sulphur 11.6%, the weight of chlorine necessary to decompose the copper sulphide would be theoretically 61.5 pounds for 100 percent extraction. At \$0.025 per pound the cost of the chlorine used as lixiviant would be \$1.54, or \$0.027 per pound copper. Some chlorine in addition to that used in dissolving copper, would be consumed in forming combinations with other ingredients of the ore, and some would be lost through adhering to the tailings. On the other hand, if the lixivium is electrolyzed in recovering the copper, most of the chlorine combined with that metal would be set free, and could be used over again. The actual consumption of chlorine would then be confined to an excess of ferrous chloride formed, which might have to go to waste, and to loss in the tailings. If the leaching department is charged with chlorine used in bringing copper into solution, then the cost of electrolytic deposition of the metal could not be so credited in the [illegible] and vice versa. So that in practice, when dealing with chlorine as [illegible] in the manner described, the expense of [illegible] deposition would probably work out somewhere between [illegible] and two cents per pound copper [illegible]

covered, and the cost of lixiviant would be practically nil.

PRECIPITATION BY IRON

The next item to be considered in the cost of leaching is deposition of the metals from the lixivium. If iron is used to throw down copper, the expense will be the cost of anywhere from one to three pounds of metallic iron, (according to the skill of the metallurgist), to one pound copper obtained in the form of precipitate. To this must be added the expense of reducing the precipitate to merchantable metal.

Precipitate, (to which the name of cement-copper is often applied), is generally a mixture of metallic copper with basic iron-salts, particles of ore, pieces of iron, graphite, silica, some antimony and arsenic, ferric arsenate, etc. The copper content naturally varies greatly. Precipitate resulting from treatment of mine-waters is generally purer than that produced from liquors derived from artificial leaching. This is partly because natural waters carry free sulphuric acid, and therefore deposit less basic salts which interfere with the subsequent refining, and those which do form are carried away by the current.

Because of impurities associated with precipitated copper, this substance is usually subjected to a mechanical treatment—washing and screening. If chlorides are left in the mixture, they occasion a loss of copper in the furnaces; but if the precipitate is bricked with lime as a binder, any chlorine present is rendered innocuous. To remove pieces of metallic iron, the raw precipitate is washed through screens with holes about one-eighth inch diameter, the iron-scrap remaining on the screen. Material passing through the screen may be washed on concentrating tables to remove the basic salts. An alternative plan has been to wash in a revolving screen under water, and in some instances the fines have been passed through launders which gradually increased in size so as to give the heavier particles an opportunity to settle out.

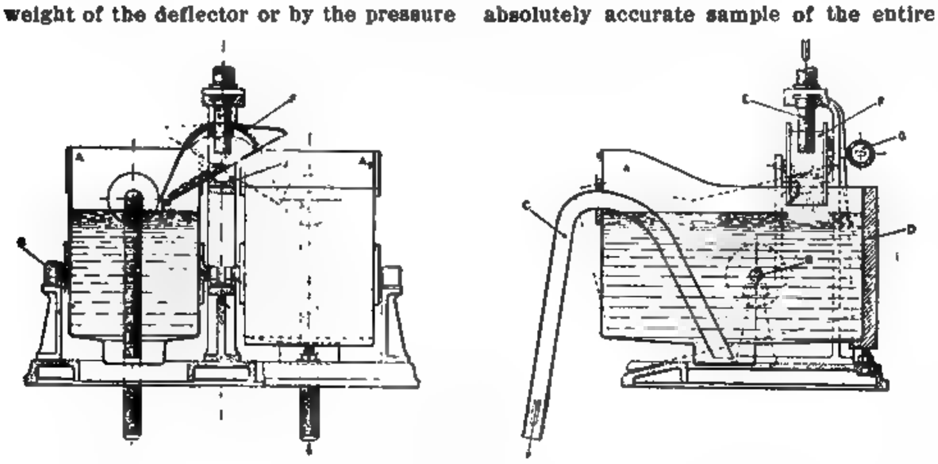
At some German works three products were made by mechanical treatment: (1) sand carrying ninety percent of the copper; (2) fines [illegible] copper; and ([illegible]

ciently, the tank is returned to its original position by the influence of the weights (D), the siphon continuing in action until the tank is emptied. As each tank assumes the position indicated by the dotted lines, it suddenly tilts the deflector (F) over so that the liquid, instead of continuing to flow into the tank, (A-1), begins to flow into the other tank (A-2), when the same operation already described is repeated and continued. It will thus be seen that both tanks are filled automatically with fresh liquid, while the measured liquid runs into a collecting tank from which it can be drawn off continuously into the zinc boxes. As each tank tips, it registers the number of pounds contained on the automatic counter (G), which is actuated by the deflector (F).

When either tank is in a horizontal position the deflector (F) rests upon the support (T), not touching the tanks, therefore the time of tipping and the accuracy cannot be affected either by the weight of the deflector or by the pressure of the running liquid in the deflector or by the resistance in the mechanism in the counter.

It should be noted that the tilting of the tanks (and consequent recorded measurement) is accomplished entirely by the introduction into them of a definite weight of liquid, irrespective of variations in volume due to specific gravity. It is customary in cyanide work to base the tonnage calculations on the volume rather than on the weight of the solution. The use of a meter of this type in cyanide plants would necessitate a change being made either in the method of taking the solution for assay or in the character of the counter (G). The amount of error introduced by a calculation of a sample which has been measured out is not very great, but it is an incongruity and should be remedied. Personally, I would favor allowing the machine to remain as it is and the counter to register the amount of solution passed in pounds, and to weigh out the sample taken for assay, but I believe that the general opinion would be to favor a counter which would register the number of cubic feet of solution. A better way perhaps would be to design a meter specially for cyanide solutions and have the tanks so proportioned that the counter will register the quantity of solution which has passed through in tons and decimal fractions thereof.

The foregoing is a description of the machine as it is ordinarily constructed to weight solution. In order to use it as a sampler it is necessary to provide an auxiliary device which will remove a portion of the solution during the period of transfer. There are several ways by which this can be accomplished. The best way would be to provide an auxiliary siphon tube of glass alongside of the large siphon and which would come into action with it simultaneously. By drawing the tip down to a fine point, the quantity of solution delivered could be regulated to a nicety. If a siphon of this kind were placed on each tank an absolutely accurate sample of the entire quantity of solution sent through the boxes could be obtained. The only objection to this method of sampling is the large volume of solution obtained. This objection can be overcome without any great sacrifice of accuracy by putting a siphon on only one of the tanks, or by cutting off the short arm so that it extends down into the tank only a short distance. By regulating the length of this arm, the size of the sample taken can be adjusted to a nicety.



A Solution Meter for Cyanide Plants.

It will be evident to all that these meters will have to be used in pairs or even in sets of three or more, depending upon the number of kinds of solution handled in the plant. Where two or more zinc boxes are used for the same grade of solution, one meter can be used for the set, as they can be arranged to take their feed from the same tank.

In order to have a check on the zinc-box "clean up," it is necessary to provide a means of sampling the solution after it has passed through the zinc. This will have to be device, of which the excellent ones whi with very little trou

The subject of pr ters and efficient s the cyanide plant is it has apparently re tention It is a ma will grow in importa ing more generally that, wherever poss methods must be s work. The machine to your attention is can be used very s ing the exact amou ent time is very mu many cyanide plant

"Thomas," said the an oxide." "Leathe "What is leather ox'ide of beef."—E

At the Bergwerks erfeld district, Pruss made with the Mu further concentratio taining intermediate ing been reduced by here to 1 mm. grain mately mixed with oil, and then passed magnet, which extr coated galena partic ly deposits them in storing bag, while t stone particles pass dump. The concent contain up to 50 pe and no more than 2 the residues.

Powder smoke ca from the face of an tion is secured by blower and the usual by reversing the dir The smoke is thus and carried away wi ed with the air of t method commonly e chine drills are use compressed air jus round of shots and continuously while t away. The disadva the use of compress sive means of secu since the smoke through the full-sec much longer time away the smoke.

Gold is dissolved by acqua regia, a mixture of strong nitric acid and hydrochloric acids.

PUBLIC LIBRARY
774920
ASTOR, LENOX AND
TILDEN FOUNDATIONS
1917

Mines and Methods

; No. 1 SALT LAKE CITY, UTAH, SEPTEMBER, 1912 Every Month

nes and Methods

Monthly by the MINES AND METHODS ...ING COMPANY, Offices 306 Tribune ..g, Salt Lake City, Utah, U. S. A.

... all communications and make all re... ...es to MINES AND METHODS

SUBSCRIPTION RATES

Copies	10c
Year	$1.00

... to United States Possessions, Cuba and Mexico

FOREIGN

Copies	15c
Year, Canada	$1.50
...ere	$2.00

CONTENTS:

...se notice that this issue of Mines ...ethods begins the fourth fruitful ...of the publication's existence. It ...ot experienced in the three years ...losed one dull moment. For the ...it has taken in working for a square ...in mining, such as prevail in ...lines of commercial endeavor, it ...een showered with congratulations ...all parts of the world. It has been ...sible to make personal acknowl...nt of all these, but we wish our ... and patrons to know that we feel ...l for every kindly expression that ...en made to us and that we shall ... future, as in the past, do the best ...n to deserve the same. When ... and Methods was started some of ...est friends doubted the wisdom of ...ove, while others became sportive ...anted to wager that not more than ...or four numbers would see the light ... Well, thirty-six numbers are now ..., and here we go for another dozen. ...in your dollar and get a receipt

THE STRIKE AT BINGHAM

Mines and Methods is not an advocate of strikes. It is deplorable that differences between employers and employed cannot be amicably adjusted without recourse to such destructive measures; but, weighing causes and conditions that impelled more than 4,000 men employed at Bingham to lay down their tools and walk out on the 18th of the present month, there seems to be no question but what the management of the Utah Copper Company is directly chargeable with bringing about the calamity. If that company has been telling the truth about its enormous earnings; if it is true, as the company's sponsors are continually declaring, that the company's earnings now amount to more than $1 a share a month on its more than 1,600,000 shares, then we say that the men who are daily taking their lives in their hands to serve the company are perfectly justified in demanding a raise from $2 to $2 50 per day for blasting and removing the rock from precipitous mountain sides; as also are those who are working in dangerous underground positions if they demand $3.50 instead of $3, or $3 instead of $2.50, as the case may be, when they know that men better treated and better taken care of, at Butte, for instance, are receiving an average of practically $1 a day more than the scale which their present demands call for? If the Utah Copper Company is doing anything like it claims, it is better able to pay miners even $4.50 per day than are the companies operating in Butte and the demands of the men ought to be met without a sign of protest.

On the other hand, if it should develop that the company is not earning at the rate claimed by it—and that was practically admitted by Manager Jackling Friday last when, in an interview with the Tribune, he said that, "nothwithstanding the present high price of copper, the operations of the company have not yet fully reflected this condition"—and if the real truth is, as repeatedly shown by this journal, that the management plays fast and loose with the shareholders of the company and the public in its vain attempts to create a "bull" market for the stock of the insiders, we then also maintain that the wages demanded by the men are not too high nor are they unreasonable.

During the year 1911, according to statistics published by a camp paper, nearly 1,000 men in the employ of the Utah Copper Company were victims of accident. Twenty-nine of these were killed and the rest were either permanently maimed or seriously injured. Not all of the other mines of Utah combined could be charged with such wanton disregard of the welfare of their employees as that, and it is not strange that finally the men, learning of the constantly claimed, boasted and paraded fabulous earnings of the Utah company, decided they should be better paid for their work and flirtations with death while accomplishing such results. Then the men charge that through a Greek employment agent of the Utah Copper Company they are required to pay a large sum to secure a job with that concern, while it was claimed by a camp paper several months ago that representatives of the company secured a portion of the blood money thus squeezed from the poor devils imported and unloaded at the company's mines just as so much inert machinery might be.

This controversy places the Utah Copper management in a bad hole and from the looks of things it will either have to make a lot of humiliating admissions or "come to time." More than a month ago the company saw what was coming and it undertook to prevent the breaking of the storm by announcing that certain classes of its employees would be given a "voluntary raise" of 25c. a day on September 1, which only placed the rate back to what it was when a previous cut was made, and when the company was just as strenuously declaring—away from home—that its dividend of $3 a share was being much more than earned.

Mines and Methods has regularly, consistently and insistently contended that the Utah Copper never has been the great earning proposition that it claimed to be; that had it not been for the periodical acquisition of new ground with real ore in it, coupled with the numerous sales of additional new stock, or the borrowing of money, it never could have maintained its position. We believe it is still in that position and had it not so blatantly proclaimed its false premises to the world it would not have created such a feeling of resentment from the miners of the camp

in which its properties are located. How the management is going to be able to recede from its position of a tremendously successful "self-contained manufacturing enterprise" and still maintain the confidence of the investing public (if it ever had it) is something we are unable to see. On the other hand, if it grants the demands of the men and continues its bold front, it will not be long until it will have to face a demand for another increase, as the example of the Butte miners will be constantly pictured to the men who do more hazardous work and still get much less for it.

The Utah Copper Company has been sowing the wind for several years; it is, apparently, just beginning to reap the whirlwind.

Utah Copper to Absorb Ohio

Considerable mystery surrounds the examination of the Ohio Copper property that is now being made. Several months ago Allen H. Rogers, then representing the Nevada-Utah interests, was in the camp examining the Last Chance claim. Since then he has returned and, it is understood, that he is now representing the Hayden-Stone interests of Boston. * * * On account of the close association of the Utah Copper with the firm of Hayden-Stone & Co., it is pointed out as possible that the company will take over the Ohio Copper company.

According to this statement, which is taken from the Bingham Review, a camp publication that is looked upon as the Utah Copper Company's personally owned mouthpiece, the long-expected is about to happen. Mr. Fritz Augustus Heinze, seemingly, is going to receive his price for the relinquishment of the Mascotte Tunnel and it is safe to predict that he is going to be well taken care of, so far as his stock interests in the Ohio Copper is concerned, as a part of the bargain. The rest of them, those who have paid their $1 a share for the purpose of aiding in the reorganization and payment of the outstanding obligations of the old company—or at least those not "in" on the deal—can take the 25c. a share for their old holdings, originally provided for, (if not yet turned in) or possibly get $1.25 for their new stock, with the $1 assessment paid.

Until the Bingham paper was prompted to "gently break the news" it was supposed by a great many innocent Ohio shareholders that the reorganization and assessment plan was arranged with a purpose of really pulling the company out of the hole. But no such luck. In effect, if appearances indicate anything, it is to be a repetition—on a smaller scale—of the Boston Consolidated and Nevada Con.-Utah Copper deals, where the insiders fixed the terms and the outsiders were compelled to take their medicine. If the deal goes through, and there is no reason to suspect that it will fail, those who have lost heavily in Ohio will have the knowledge that there is nothing to prevent them buying Utah Copper shares and, to make the settlement with Mr. Heinze and the rest of the insiders easier, those who get buncoed in Ohio will likely be granted the privilege of taking a stated portion of the new shares of Utah Copper stock that will, without much question, be sold to meet the purchase price of the Mascotte Tunnel property from Mr. Heinze. To make this new stock issue look all the more attractive for this play, the Utah Copper market manipulators have been steadily "washing" the price up for more than a month past. This feature of the scheme has been working in the face of a market that every half-honest reporter has repeatedly shown to be wholly professional—in a market which the public has been leaving severely alone for so long that even Daniel Guggenheim became discouraged and sailed for foreign lands bent on finding customers for his "securities" elsewhere.

These few remarks are offered so that the lay shareholders in Ohio may be enabled in a measure to grasp the situation and decide for themselves what is best to be done in case they find themselves in the boat that such a consummation of their utter route as we have outlined is visited upon them. We cannot swear that it will turn out just as we say—we simply draw our conclusions from what has happened before.

As for ourselves, we have long believed that Ohio and the Mascotte Tunnel properties would go the Utah Copper, because it provides the only outlet for the underground ore of the latter company. The first move in that direction came when the Utah Copper Company secured permission to extend the Mascotte Tunnel workings a distance of some 1800 feet in order to connect with the Hayden drill hole, sunk from the main pit of the Utah Copper's steam shovel workings; it became more apparent over six month ago when Utah Copper experts were engaged in sampling the Ohio mine. Both of these events were recorded by Mines and Methods at the time, and their significance was pointed out.

At different times, lately, the Utah Copper's publicity agents have told of the drill-hole prospecting at depth which has been going on and—as this work is said to have shown that, within certain prescribed and narrow limits bordering the Quinn fissure, ores carring 2 to 4 per cent was encountered—the natural thing to expect has been that a means of getting at this ore would have to be provided, at stated above. It does not appear that much is to be expected from Ohio ground at depth and it is claimed that only a few unimportant streaks of ore were found in running the 1800 feet from the Mascotte tunnel's workings, through Utah Copper possessions, as related above.

Those of our readers who have been following what we have had to say concerning the management of Utah Copper affairs from the beginning will remember that when the company, more than three years ago, was claiming that it had a self-contained manufacturing proposition, we showed that it had nothing of the kind; that it would be down and out within two years if it depended on making money with its steam-shovel methods of mining, in the territory it then owned. It will be recalled that our statement to this effect was fully justified inside of six months, when the company was compelled to secure the Boston Consolidated—not only to secure working room for the steam shovels, but also to secure underground ore with which to "sweenten' its steamshovel product sufficiently to give it the appearance of being commercially valuable.

When that deal was consummated, and knowing conditions, we made the declaration that even the Boston Consolidated acquisition could be relied upon only to defer the day of reckoning for probably another year or so. Within the next six months the Utah company was forced to buy the Barnsdall group of eight claims—in fact, it had to buy this group twice, for when the original deal was made the owner did not know that the Utah Copper Company had been mining out the rich ore from the group for a long time previous; but when he found it out, through Mines and Methods, he compelled the Utah Copper Company to shell out 6650 shares of its stock as a pacifier. That purchase of the Barnsdall group has saved the life of the Utah Copper Company up to the present time; it also has clinched the statement of Mines and Methods that the company must continue to secure new ground with real ore in it or quit.

Three years ago, and every few months since, the management of Utah Copper has been declaring in its reports that it would soon be ready to discontinue underground mining altogether; but each succeeding report has shown that, had it not been for the ores secured underground, "possible" and "probable" ore would have been about all that it could have supplied to its mills. These matters are mentioned to show that Mines and

is has never made a single mis- dealing with the mismanaged af- f this company. Our contention was impossible to profitably con- team shovel mining operations at perty has repeatedly been verified mphasized in the different issues stock, or borrowing money against ale of which has been neces- meet the enormous expense of ng overburden, remodeling mills, order that the receipts from the copper might be made to appear ntly profitable to justify the pay- of dividends.

a few months ago no less an au- that Mr. Heath Steele, a promi- ining engineer of New York, conclusively that if the Utah Company had properly charged duction of copper what should een charged against it, the 1911 ds would be shown to have not arned by $1,500,000 at least. For two years and more every suc- report of the company has shown e grade of the ore treated was hing, until now it ranges at about 1.4 per cent, and this with all the ming" that can be given it by lition of the better grades of ore from underground workings in ston Con. and Barnsdall areas. In antime the amount of overburden e steam-hsovels are required to is increasing at a rate which, as nths go by, will climb to propor- hat even a 17¾c. copper mar- not sustain.

e face of it all, and while an ef- being made to convince the world e company is making a clean pro- etter than $10 a share from its m operations—as a result of its ficent" steam-shovel methods—the ment seems to be dickering for ce to add other properties to its s in order that underground min- y be continued and the deception practiced may not become appar- il the public shall have been bam- into relieving the insiders of the they have been forced to bear past four or five years in absorb- floating stock and sustaining the

———o———

lean steel tapes that are badly the use of a mixture of lubricat- and cement is efficient. While icular proportions are necessary, ld not be so thick that difficulty in using it. Care should be taken rub too hard as the action is pow- d, used without judgment, wears metal.

THAT "MILL ROLLER" SUIT

On the 16th of the present month the Salt Lake Engineering Company filed a suit in the Federal court for $36,000 against the Ohio Copper Company claimed as due for ten sets of Wall's corrugated, horizontal crushing rolls and ten sets of Wall's vertical rolls, all of which, with the exception of four sets of corrugated rolls previously installed, were placed in operation at the Ohio company's mill, at Lark, Utah, between September 25, 1911, and February 20, 1912. In the abstract there is nothing in this of particular public importance, and the matter would not be mentioned here only that from the first day it became known that the Ohio company was going to equip its milling plant with the Wall patent rolls, no opportunity has been allowed to pass by interests unfriendly to the patentee of the rolls to prejudice the mining profession against their adoption and use in ore-reducing plants.

The filing of the suit in question was the signal for a portion of the local press —the Evening Telegram—to state that this $36,000 was "alleged to be owing for A SET OF MILL ROLLERS," certainly cognizant of the fact, through their familitary with ore-treating practice, that such a statement would seem ridiculous and tend to cast aspersion on the inventor and the claim for remuneration by plaintiff company.

It is due to all parties in interest that something of the truth should be known. Since the first installation of the Wall crushing rolls in the Ohio mill the company adopting them has been able to make a showing that it never previously dreamed of making; where it was previously losing a great deal of money on the treatment of much better ore than it has handled for many months past, the management has been able to show in official reports that its net earnings had reached more than $35.000 per month: that in the last year these net earnings had exceeded $300.000. In the face of statements made by the company's management showing what good work the Wall rolls had been doing, eastern market publications, inspired, unquestionably, by subservient tools on this end of the line unblushing declared that Wall's "contrivances" had failed to disclose any merit Such dainty morsels of misinformation have been reproduced by a sycophantic local press with utter disregard of any favorable mention that may previously have been made on authority of Ohio officials, and with a purpose, apparently, of doing the bidding of some one to break down and crush anything and everything that is not initiated and promulgated as worthy from as miserable lot of incompetents as ever afflicted the mining profession.

The terms of the contract under which the Ohio company was enabled to install the Wall rolls could not have been more liberal. If they did not do all that was claimed for them the company had the right to return them in whatever condition they might be, without cost to the provisional purchaser. For mutual reasons the price was made extremely low and payment was to be made only from net earnings of the company. And, while the company has been reporting substantial net earnings for many months no proffer of payment for the crushing installation has been made to the Salt Lake Engineering Company, which supplied it.

The bringing of suit for collection was prompted, not through any desire to cause the Ohio company trouble, but because it has been apparent for some time that the control of the company and its mines and mill would pass into the hands of a corporation known to be hostile to anything or anybody having the remotest connection with the name of the inventor of these peerless crushing machines, machines that have demonstrated the Ohio Copper Company's ability to make money in a small mill on ore carrying barely 1% copper at a much better rate than has ever been possible with 1 5% ore in the mammoth mills of the Utah Copper Company, for instance.

These facts are related in the interests of truth and for the benefit of those whom it has been the evident purpose of purveyors of falsehoods to deceive.

———o———

The reason that window panes are whitened in a building not yet completed, is explained by a building contractor as reported in the New York Times. "We don't plaster them over with chalk to prevent the public from seeing the unfinished condition of the interior, but to keep the workmen from battering out the glass. Transparent glass looks just about as transparent as air to the man who is moving a wooden or iron beam in a hurry, and he is likely to ram the end of it through an expensive window, but when the glass is coated with white it becomes visible, and the workmen hand their material in through the door."

———o———

The life of machinery depends upon the treatment that it receives.

———o———

To preserve iron against rust, immerse it for a few minutes in a solution of blue vitriol, then in a solution of hyposulphite of soda, acidulated with chlorydric acid. This gives a blue-black coating which neither air nor water will affect.

UTAH COPPERETTES

No matter what the ultimate outcome of the strike at Bingham may be, it is not believed that it will be extended to the properties of the Alaska Gold Mines Company, in the mountains back of Juneau, even though they are under the management of Mr. Jackling.

* * *

The "New York Curb" devotes a great deal of its space these days to the stereotyped boosting literature of Utah Copper, Braden, Ray Con., Chino and Alaska Gold Mines, thus suspiciously indicating that it, too, is out for the dough. If it keeps "in tune," however, it will have to cut some of that "Spencer" stuff, because it is sure to detract from the "investment" value of the boost dope referred to.

* * *

Brokerage papers, "Market Letters" and correspondents of different mining magazines and newspapers, have been bowling along an interview with William B. Thompson, recently returned from a pleasure trip through Europe, in which he is made to say that "one firm of bankers in Paris has accumulated 250,000 shares of Utah Copper and is still in the market." We have known all along that strenuous efforts were being made to unload Utah Copper shares in France, but we did not suppose that one firm of "bankers" (or brokers) had been commissioned to try and sell so many; and we use the word "try" advisedly, because all the reliable evidence of the past year's struggle on the part of the Utah Copper Company's publicity department to create a demand for the stock —and particularly in France—has proven anything but "a howling success." These 250,000 shares referred to by Mr. Thompson are probably those which remained of the 300,000 originally listed by individual owners three years ago, and which have not yet been returned to this country. Mines and Methods showed more than a year ago that practically all of the first shares sold in Paris were thrown on the market at a loss by the Frenchmen who had bought them and that they were all taken in by the Utah company's representatives in this country. Again, it may be possible that the entire holdings of Mr. Thompson, consisting of 50,000 shares, all of which it is said were disposed of at about that time, have found lodgment in the strong box of some fool Frenchman. This, together with the number of shares mentioned by Mr. Thompson, would account for the entire amount listed, as related in this magazine at the time.

"The report of D. C. Jackling and A. F. Holden covering the Alaska Gastineau property should be studied carefully by investors who fancy shares in precious metal mines," says the New York correspondent of the Mining & Scientific Press. In this we fully concur, and to make it easier for investors we are reproducing that most illuminating document in this issue. We shall also give it space next month, so that men who do "invest" may commit it to memory and forever after know just what kind of bait they swallowed.

* * *

"Copper stocks were all firm. Utah Copper was picked up by bargain hunters, as were Chino and Ray Consolidated."—From Shotwell's New York market dope in Salt Lake Tribune of Sept 20th, just after the miners' strike at Bingham. In the same issue (Logan & Bryan market letter) we find this: "Utah Copper suffered from the liquidation incident to the unsettled state of affairs in the Bingham camp. * * * Of course, in the case of mining equipment being damaged, the company loss might be great, but from the standpoint of ore reserves, etc., the property could not be damaged." Of course not. Who could damage ore reserves the "indicated" recoverable values in which amount only to about fifteen pounds of copper per ton? Besides, you have seen how great tonnages are added to the reserves of the Utah Copper mines by simple calculations and revisions of the mine maps, as was done in the annual reports of the company for 1910 and 1911 when more than 200,000,000 tons were added by just a few strokes of the managerial pen.

* * *

That Mr. Jackling is a wonderful manager is not questioned in the least. The past ten years have brought him from an obscure position, as a metallurgist for a small mining company, to the position of the leading mining man of this country today. But, notwithstanding this, Mr. Jackling has had failures and a number of them. We can mention quite a few properties that have not been the success he and his associates in them have anticipated, and for this reason it would be well to thoroughly investigate the possibilities of the Alaska Gold Mines company before rashly making an investment in these shares. * * * We read that in his latest venture * * * over 2,000 stockholders have been enrolled on the stock ledger of the new company. We venture to say that not five per cent of these have investigated tl osition. * * * The lowest co given on mining underground ore Utah Copper is 68c. a ton and bodies in this ground are sevei dred feet in width and quite s easy to handle. Should the Alas be mined equally as cheap, ther still be the milling costs to add amount and, if it became nece use cyande, the costs would prob a great deal higher than the small allowed for this purpose.—Excer Market Letter of Dern & Thom Lake.

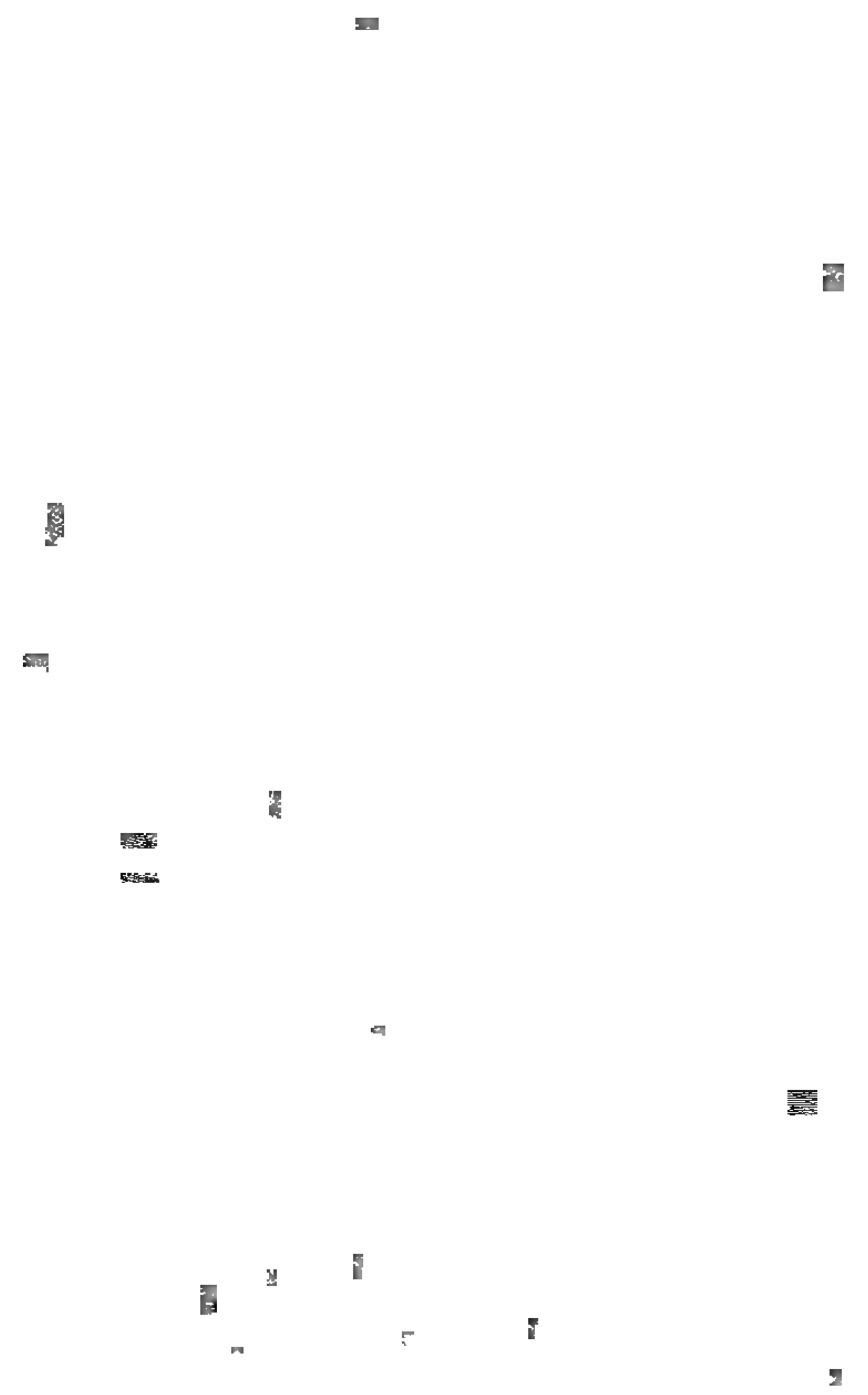
What do you think of that? ever before—outside of the p Mines and Methods—see or hear body in cold print questioning infallibility of Mr. Jackling? A here in his "home town," at th call Mr. Jackling a "wonderful m and then to charge him with h number of failures to his credit the same time to almost threa with exposure by declaring that " mention quite a few," is certain some. "Tintic," the title unde the market letter referred to is has evidently not been "gathe and "greased."

* * *

Judging from the remarkable " and activity" of Utah Copper s the New York exchange since t pany's mines and mills were clos as a result of the strike, it woul such a bad thing for the comp the president of the Western Fe of Miners did follow up his th cause a close-down of the Ray an When it can be shown that a company, so far, at least, as the price of its shares are conce worth more "dead" than "alive,' the use of being burdened v bother and expense of operating ern brokers and other "bull" d including the "echoes" on this e line, have been explaining for 1 or more that the closing of Utal is going to create a famine in th metal market and, as the pric metal must as a result advance the shares of company stock w that much more, particularly as reserves" cannot be either dan frittered away by the strikers. the stuff!

———o———

When boards have become dis is, hollow on one side and rou the other, they may be straigh exposing them in the sun, round



Geological Survey's Sketch Map, showing the Location of the Perseverance Property and the Sheep Creek Divide, Over and Beyond Which the Alaska Gold Mines Company Says It Will Operate. Limits of Lode System is also Shown.

Perseverance deposits are stringer leads in which the vein stuff is distributed through the country rock in the form of irregular vein fillings. The black slate, which is the principal rock, is intruded by numerous dikes and both of these rocks are cut by the ore stringers. * * * The structural trend of the country is about N. 40° W., as shown by the slaty cleavage, the course of the diorite dikes and the strike of the foot wall of the slate band in contact with the greenstone. * * * Mineralization extends through nearly the whole length of the lode system in Gold Creek, and is continued on the Sheep Creek side of the divide toward the southeast. * * * From the Ebner property on Gold Creek to the Silver Queen mine in Sheep Creek the distance is about five miles. The Ebner ores contain gold and silver in the proportion of about 7 to 1 by weight, while in those from the Sheep Creek mines the amount of silver is several times that of the gold. It seems that there is a progressive increase in the proportion of silver from northwest to southeast, for on the Perseverance ground the silver is from three to ten times the gold by weight, as shown by a large number of assays made for the Alaska-Perseverance company. * * * On the Perseverance property the veins are very much broken, so that it is impossible to mine the vein stuff separately from the country rock.

Time and space forbids going farther in this delineation of the fallacies of the so-called "tremendous possibilites" of this magnificent (?) propositon which, in the presentation by the promoters, is counted as "analagous to the low-grade 'porphyry' mines," with the added advantage, of course, that gold is not subject to market fluctuations, like copper.

FOR TRUTH OF HISTORY

Editor Mines and Methods:—In your August issue, this year, is a very valuable and interesting article, by C. F. Z. Caracristi entitled "Mineral Development South of Canal Zone." The subject would fill a book; but he has condensed it to the limits of his article and yet makes a most readable presentation. The region described is, acre for acre, all things considered, the richest in the world. Panama was only a province of Columbia, until our government forcibly wrested it from her, and the eternal verities require that we should return it to her, which can be done at no cost to any one. She has always been a devoted friend of the United States, and would make a better neighbor than its present government and people.

My object in writing is more than for anything else to correct an error. Senor Caracristi has fallen into, and others, more than he. He says:

"The interior of Columbia presents a vast field for future development when the railway facilities are to be had for getting into ths country, and when the canal is completed and the proposed inter-continental railway—the dream of the late Hinton R. Helper, who projected the idea before a convention in the city of St. Louis in 1848—becomes an accomplished fact."

The truth of history is that Colonel William Gilpin, Colorado's first territorial governor, was the person that made the speech on the subject and at the time named. He was then and had been for a long time a resident of Missouri. In 1873 he published a book entitled, "Mission of the North American People." Its introductory page has this legend:

"The Central Gold Region; the Grain, Pastoral and Gold Regions of North America, with some new views of its physical geography and observations on the Pacific railroad, by William Gilpin, late of the United States Army. First published in 1860."

In that first publication is a map of the world, his own, "Delineating the Contrasted Longitudinal and Latitudinal Form of the Continents; the Isothermal Zodiac and Axis of Intensity, Round the World, and the Line of the Cosmopolitan Railway and its Longitudinal Feeders."

In that 1860 publication was laid down, among others, a line of railway up and down the Pacific coast of North and South America. Mr. Helper evidently was ignorant of Gilpin's work, and believed his was the pioneer thought. In confirmation of that belief and of my correction, I submit the following from a letter he wrote on the 30th day of November, 1896, to his friend:

"His Excellency, Hon. Eurique Dupay de Lome, Envoy Extraordinary and Minister Plenipotentiary for the Kingdom of Spain, Distinguished Sir: * * * This being the 30th day of November, 1896, which is one of my most welcome and delightful anniversaries, I am vividly impressed with the fact that it is just thirty years today since I conceived, under somewhat extraordinary circumstances, the idea of an inter-continental railway through the three Americas, from Behring Strait to the Strait of Magellan, which, when built * * *"

This was six years after Governor Gilpin had mapped and elaborated the idea, and as I stated above, it is due to the truth of history these things should be known. I was familiar with his two books, and besides was honored by his personal friendship.

HENRY ALTMAN.

New York, Sept. 7, 1912.

MINE FOOD FOR WINTER

In the accompanying table is given a list of groceries and provisions consumed at Iron Mountain, Idaho, by twenty men (average) including cooks, during four winter months in 1909 and 1910, says Percy E. Barbour in the Engineering and Mining Journal. In addition to the list, lard was fried out of the two hogs listed as fresh pork. There were not enough fresh vegetables to last through the period and owing to the winter and snow-blocked roads, the can snowbound practically all of the no more could be obtained an place was taken by canned goods. the amount of cabbage, turnips, p and one-half more onions and should have been provided. In a to the list were used sundry amounts of spices.

Fresh beef	
Fresh pork	
Fresh mutton	
Fresh fish	
Fresh chickens	
Fresh eggs	
Case eggs	
Ham	
Bacon	
Butter	
Flour	2
Graham flour	
Corn meal	2
Coffee	
Potatoes	
Carrots	
Turnips	
Cabbage	
Onions	
Parsnips	
Apples	
Salt	
Dried peaches	
Dried apples	
Dried apricots	
Dried prunes	
Raisins	
Condensed milk	
Canned corn	
Canned tomatoes	
Canned peas	
Canned peaches	
Canned pears	
Canned pumpkin	
Canned oysters	
Maple syrup	
Crackers	
Macaroni	
Cheese	
Sugar	9
Oatmeal	3
Beans	1
Molasses	
Jelly	3
Vinegar	
Baking powder	8 (lar
Pickles	
Lard	
Catsup	
Tea	
Chocolate	
Cocoanut	
Soda	
Yeast foam	
Cornstarch	
Chowchow	
Pepper sauce	
Currants	
Hominy	
Matches	
G. S. soap	
Tar soap	
Ivory soap	

The isolation of the camp m cost of these supplies high a thirty-mile wagon haul was ex The total payroll deductions fo were $2318 ($1 per man per d just about equaled the cost of the boarding house, paying for plies and the cook's wages.

Rapid drilling by hand is not plished by use of heavy hamm forceful blows, but by hammers o size handled by men who know strike the blow that will cause t to cut and keep the bottom of t clear so that the drill is working rock and not on a lot of loose fra This is an art, and is only lea experience.

LEACHING APPLIED TO COPPER ORE* (XXII)

ROASTING PAEPARATORY TO LIXIVITATION.

By W. L. AUSTIN.†

Most solvents ordinarily employed for extracting copper from its ore attack the metal in its oxidized form more readily than when it is combined with sulphur. This is because oxidation must take place antecedent to leaching when, for instance, such reagents as sulphuric acid, ferric sulphate, and sulphurous acid are used in the lixiviation of a sulphide ore. It is obvious that if the solvent finds the metal present in oxide form, there is less work to do than when it must first be oxidized before going into solution. In leaching with sulphuric acid it is necessary that copper sulphides should have been previously oxidized, otherwise, with the weak solutions employed the metal is not satisfactorily extracted. If ferric sulphate is used as lixiviant, it acts both as an oxidizer and solvent, first oxidizing the copper sulphides and then bringing them into solution. When chlorine is the active agent in the lixiviant the copper sulphides are also attacked and dissolved, the reactions being materially assisted in the cases of some chlorine lixiviants by the oxidizing character of the salts present. Hypochlorous acid, and hypochlorous salts, are such oxidizers.

In considering the lixiviation of a given ore it therefore becomes of importance to decide whether oxidation of the copper constituents shall be effected by a preliminary fire treatment, or through the medium of chemical reagents: the relative expense incurred in carrying out the respective methods will naturally decide the issue. Instances may occur in which it will be cheaper to oxidize with the help of ferric or hypochlorous salts, but in most cases where oxidation is essential it will be found more economical to resort to roasting.

Oxidizing the copper content of an ore is not the only reason for roasting before leaching is undertaken: this treatment has a further beneficial effect, in that, by heating, the material is rendered more accessible to the solution. This is especially marked in the case of ore inclined to slime. It sometimes happens that ore which previous to roasting was almost impervious to solutions, is rendered quite leachable by light roasting—the water of hydration is driven off. With ore containing carbonates and sulphides, carbonic acid and sulphur are expelled by heating, and the mass is thereby rendered porous and absorbs solution.

Light heating with some classes of ore is said to effect a rearrangement of the molecules, and lays the copper more open to attack. For instance, Froelich (Imperial German patent No. 180,307 of 1902) has shown that chalcopyrite can be made amenable to leaching when it is heated for a short time above 200° C. without admission of air. By this treatment one-fourth of the sulphur content is said to distil off, and the color changes from blue-black to dark-brown. No copper oxide is said to form. Froelich represents the probable transformations by following formulae. $2CuFeS_2 = Cu_2Fe_2S_3 + S$.; $Cu_2Fe_2S_3 = Cu_2S + 2FeS$. A method of roasting which recovers part of the sulphur by distillation, produces no sulphur dioxide, and transforms chalcopyrite into a leachable product, certainly possesses the appearance of merit in these days of "smoke farmers."

Roasting copper ore for lixiviation, and roasting the same ore for smelting, are two distinct problems. In the latter instance the operation is carried only so far that sufficient sulphur shall be left in the roasted product to provide for a suitable matte-fall in the subsequent smelting: it is immaterial how the components of the roasting-charge rearrange themselves during treatment. On the otherhand, if the ore is to be leached it makes a very great difference in what combinations the copper, iron, etc., issue from the furnace, and the temperature at which the roasting is done has to be carefully watched. Failure to observe necessary precautions has been the cause of a number of disappointments in leaching undertakings.

ROASTING CHALCOPYRITE.

Copper occurs associated with other elements in the various mineralized forms which the hydrometallurgist is called upon to treat. Among the simplest of these are the carbonates and natural sulphates. The metal is also found in quantity combined with silica as chrysocolla, and as oxides; but by far the most common cupriferous minerals are the sulphides—chalcopyrite and chalcocite. It has been stated that copper is mineralized as chalcopyrite in two-thirds of all cupriferous ore treated.

The components of chalcopyrite are firmly combined, and authorities do not agree as to the grouping of the individual elements—but this is of minor importance. The essential fact is that the combination is very difficult to break up, as many metallurgists have from time to time reported who have tried to lixiviate raw chalcopyritic ore with solvents commercially available. Some form of preliminary oxidizing treatment has always been found necessary—weathering roasting, or chemical oxidation. Of these different methods, roasting is the one to which recourse is generally bad.

The progressive stages of oxidation through which the pulp passes during treatment in an oxidizing furnace, are explained in text-books and need not be repeated here. What concerns the hydrometallurgist most are the forms in which copper and iron are combined with other elements in the final products. If roasting is conducted at too high a heat, ferric oxide combines with cupric oxide to form a ferrite (CuO, Fe_2O_3) which is insoluble in most dilute lixiviants. This ferrite is produced with extraordinary ease even in the wet way. Ignited, black cupric oxide rapidly decomposes ferric chloride solution, producing a brownish-yellow ferrite precipitate (Kohlmeyer in "Metallurgie" 1910 page 297). If caustic potash is cautiously added to a solution containing equivalent amounts of ferric chloride and copper sulphate (or cupric chloride), so that no copper remains in the liquid, a voluminous dirty brown precipitate comes down. After ignition this precipitate appears as a clove-colored ferrite, free from cuprous oxide.

In roasting chalcopyrite the formation of copper ferrite is supposed to be brought about as indicated in the following formula:

$Cu_2S, Fe_2S_3 + 13\ 0 = (CuO)_2, Fe_2O_3 + 4SO_2$.

Thomas ("Metallurgie" 1904, pages 8, 39, and 59) proved experimentally that in the commercial lixiviation of chalcopyritic ore with ferric sulphate it is necessary to so conduct the roasting that sulpho-ferrite (chalcopyrite) shall be decomposed without forming oxy-ferrite. He also found that all copper ferrites resist the action of ferric sulphate solutions

In addition to the formation of copper ferrites in roasting cupriferous ore, combinations of copper oxide with silica are also to be guarded against. If the temperature in the roasting furnace is

* Copyright, 1912, by Mines and Methods Publishing Company.

† Mining Engineer and Metallurgist, Riverside, California.

sufficiently high, fusible copper silicates form, coating the cupriferous minerals and protecting them from the action of solvents in subsequent leaching operations. In roasting Anaconda slimes (for analysis see Mines & Methods, 1912, page 556), Hollis and associates (Bulletin of the Colorado School of Mines, Vol. IV, page 113) found that when a batch was roasted at red heat in an assay muffle until all sulphur had been given off, the copper was insoluble either in dilute or concentrated sulphuric acid, or in ammonia. This fact was explained by the assumption that the copper was either converted altogether into silicate, or that the fine particles were covered by a film of silicate. Hunt (Transactions of A. I. of M. Es., Vol. X, page 18), found that in roasting sulphide ore, in addition to soluble cupric sulphate, the pulp contained insoluble oxides of copper, and a small portion of a cuprous compound, which though insoluble in water was dissolved by a solution of hot, strong NaCl, and was thought to be a cuprous sulphate or sulphite.

Thomas showed ("Metallurgie," 1909, page 474) that when a chalcopyritic ore is roasted at a very low temperature, a product is obtained in which copper is partly in form of sulphate, partly as free oxide, and partly as undecomposed sulphide, but free from FeS. A roasted product of this description was said to leach easily. On the otherhand, Kerl states that undecomposed sulphides in roasted ore are not attacked by dilute acids.

TEMPERATURES IN ROASTING.

When making a sulphating roast, the temperature of the furnace is of the greatest importance. It should be controlled with the help of an electric pyrometer, and must be restrained within prescribed limits. It is well to note the following: at 100°C. the last mechanically associated water evaporates. At 230° a part of the sulphur of the pyrites and chalcopyrite escapes. A yellowish-grey copper ore (20 percent copper) becomes darker: at 260° it is for the most part dark-brown with faintly shimmering scales, some brown in color, others displaying iridescence. At 340°C. the characteristic odor of sulphur dioxide may be discerned, and at 400° the roasting is in full action. After that the temperature must be very carefully watched to prevent undue rise.

Another writes states that sulphur is separated from copper sulphide, and begins to burn, at 325°C.: anhydrous ferrous sulphate is decomposed at 590°: and copper sulphate begins to decompose at 653°, producing a basic, yellow sulphate of the composition $CuOCuSO_4$. At 702°C. this basic sulphate begins to separate into cupric oxide and SO_3. Zinc sulphate is decomposed at 700°C.: lead sulphate at above 1000°.

The formation of iron and copper sulphates takes place at about the same temperature, but more copper-sulphate is formed than iron-sulphate at corresponding degree of heat.

In treating a certain concentrate, it was roasted for several hours at about 450° to 480°C. to produce copper sulphate. After the copper sulphate was formed, the temperature was increased to change iron sulphate into ferric oxide. There was no danger of destroying the copper sulphate already formed, provided the heat was not permitted to exceed 600°C. During the latter hours of the roast the temperature was raised to about 560°, and in this manner the decomposition of iron sulphate was effected to a considerable extent, which was of importance in the following leaching, for thereby an excess of iron was avoided in the solution.

Laboratory experiments made at the Colorado School of Mines for the purpose of ascertaining the best temperatures for roasting the Anaconda slimes previously alluded to, so as to produce the largest amount of copper sulphate, are interesting. These tests were carried out in a gasoline assay-muffle, at a temperature between a dull-red and a bright-red. Roasting dishes were used, and stirring was done by hand at intervals of about five minutes. In the first series of tests the roasting was of short duration, and temperatures were high.

No. of Test	Time Min.	Temp. °C.	Percent Copper Extracted from Roasted Pulp by		
			Water	2% H_2SO_4 Sol.	10% H_2SO_4 So
1	3	640	6.2	27.5	38.6
2	5	"	16.8	43.2	53.3
3	7	"	20.7	46.5	62.3
4	9	"	24.7	57.2	69.6
5	11	"	20.2	62.8	70.1
6	13	"	17.4	65.1	69.0
7	15	"	20.2	63.4	72.3
8	20	"	....	16.8	18.5

SULPHATES DECOMPOSED BY PROLONGED HEATING.

In the above tests it will be noticed that the best extraction with water was achieved after the pulp had been roasted nine minutes; the best with two percent sulphuric acid solution after 13 minutes; and the best with ten percent solution after 15 minutes. This shows that the sulphatizing of the copper was very rapid, and also that the sulphates were even more quickly destroyed. After twenty minutes roasting there was practically no copper sulphate remaining in the pulp, but there was still some copper oxide left which had not gone into insoluble combination with other elements, and could therefore be leached with strong acid solution. The temperature given (640°C.) was clearly too high for sulphatizing, because in none of the tests was the copper brought into condition for profitable extraction.

The next series of tests was made at a lower roasting temperature—just below a dull-red heat, presumed to be 520°C. The results are given in the following table:

No. of Test	Time Minutes	Temperature C°	Percent copper extracted from roasted pulp by	
			Water	10% H_2SO_4 solution
9	15	520	43.5	87.9
10	30	"	55.2	92.8

The effect of the reduction in temperature is marked; but that the muffle was still too hot to produce the best results was clearly shown in the next tests, which were made without any visible color at all. It should be remarked that in lixiviating the roasted pulps 100 cu. cm. of solution was used in each case—the weight of the raw slimes was ten grams in each test.

No. of Test	Time Minutes	Temperature C°	Percent copper extracted from roasted pulp by	
			Water	10% H_2SO_4 solution
11	15	450	61.4	99.1
12	45	"	64.6	99.6

At this temperature the molecular construction of the chalcopyrite was broken up so that a ten percent sulphuric acid solution could attack the copper; but either the heat was insufficient, or the time too short, to convert all the metal into sulphate soluble in water alone.

In none of the above tests was temperature accurately determined. To remedy this defect a sheet-iron drying oven, with two shelves, was fitted with a high-temperature thermometer. A long series of experiments was carried out with this apparatus, but the temperature could not be raised above 270° to 280°C. on the lower shelf. It was found, however, that by roasting six hours at 282°C., 94.6 percent of the copper content of the roasted pulp could be extracted with a ten percent sulphuric acid solution. This is further evidence that the molecular constitution of chalcopyrite may be broken up at a comparatively low temperature, and the copper content rendered leachable with sulphuric acid.

Another series of experiments was then carried out in the same muffle as at first used, with the difference that Le Chatelier's electric pyrometer was employed to determine the temperatures.

No. of Test	Time, Minutes	Temperature C°	Percent copper extracted from roasted pulp by 10% H_2SO_4 solution.
14	75	480	86.6
15	"	"	91.1
16	135	450	85.1
17	150	490	87.9
18	120	440	95.5
19	45	"	96.0
20	30	320	76.3
21	60	"	76.8
22	45	"	85.3
23	90	"	90.2
24	45	360	85.3
25	60	"	91.8

ECT OF THICK ORE-BEDS IN ROASTING.

hese last tests it is interesting to ıat No. 19 gave 96 percent extrac- ter 45 minutes roast at 440°C., and , 92 percent after 60 minutes at The conclusion reached by the do experimenters was, that the emperature for sulphatizing the ıda slimes tested, lay between 400° 0°C., and that 45 minutes roasting d. Some larger batches of slimes, l for the purpose of making leach- d electrolytic tests, gave results indicated that 45 minutes was not ınt time when a thicker ore-bed ised. Whereas, the small tests l percent extraction with ten per- ılphuric acid solution, only 76 to ent was extracted from the larger

her data relative to temperature ting ore for leaching purposes will ın in future articles; but some ex- nts made by Vondracek (Oesterr. 1906, page 437) with a mixture lcopyrite, argentite and quartz, is ting in connection with what has r been stated. The experiments arried out in small dishes while g a current of air over the pulp. ish was roasted separately and the emanating from the next follow- ih were allowed to pass over the ing one. Each roast was then l with an equal quanity of water, solve the soluble salts. The fol- table gives the percentages of the at metals contained in the original ıich were brought into solution.

[illegible]	Temperature of roast	Percentages going into solution		
		Silver	Copper	Iron
	750°C.	31.3	17.5	Trace
	650	84.4	83.4	1.2
	500	90.6	88.0	1.0
	400	87.5	....	5.1
	300	96.9	95.9	6.1
	200	93.8	88.4	10.7

ırge percentage of the silver con- ' the pulp brought into solution is ırthy.

TITY OF AIR ADMITTED TO ROASTING FURNACE.

oasting sulphide ore an excessive of oxygen may have deleterious re- 'or when sulphides have been heat- a certain point, the elements of they are composed unite with the , of the air, and the heat liberated xceed that desired for the opera- In this manner it may transpire ırticles of ore become fused, a con- which is, of course, very detrimen- subsequent leaching. For this it is desirable to always have the ion of air to the furnace under , and to watch the pyrometer care- : certain critical points in the fir- as soon as combustion of the sulphides starts, the air supply should be shut off temporarily. However, in carrying out a sulphatizing roast properly, it is essential to have a surplus of air in the furnace after danger of too free combustion of the sulphides has passed. It is thought probable that the formation of sulphates is assisted by the catalytic action of certain metallic oxides, and if sufficient oxygen is present, sulphur dioxide formed in one part of the furnace may be further oxidized, and in this state can unite with cupric oxide in another part. Sulphur dioxide and oxygen act upon one another very slowly when brought simply into contact, but there is quick action in the presence of a catalizer such as ferric oxide. The formation of sulphur trioxide should be assisted by supplying the oxygen necessary to raise sulphur dioxide to the higher degree of oxidation.

The admission of too much air to a roasting furnace may have the further effect of cooling the partially roasted charge below the point where the proper chemical reactions can take place. This is brought about by heating the excess of air at the expense of the furnace walls and charge. Therefore, in designing a furnace the proper proportions with relation to the work to be performed, must be carefully considered, and it is easy to see that a furnace admirably adapted to one class of roasting may be disappointing when called upon to perform another.

Should insufficient air be present in the gases passing over a roasting charge, the sulphur dioxide can reach proportions where it smothers the combustion. Sulphur dioxide is one of the most efficient fire-extinguishers known, and has been employed for that purpose.

DEGREE OF SULPHATIZATION OBTAINED.

It was shown in the foregoing that a high percentage of copper sulphatization can be obtained with proper roasting, even on a low-grade ore. It is obvious that when the constitution of an ore is such that a sulphatizing roast is possible this is the best method for adoption, because then the ore itself provides the leaching agent.

The richer an ore is in copper, the easier it has been found to bring a large percentage of the metal into solution. At one works where a 20-percent concentrate was leached, there was seldom less than 98 per cent of the copper rendered soluble in sulphuric acid. In the southern Tyrol concentrates were leached which analyzed 7.13 per cent copper. This material was roasted in a horizontal revolving drum so that from 95 to 96 per cent of the copper content was made soluble in sulphuric acid. Over 65 per cent of the copper was obtained in form of copper sulphate, soluble in acidulated water, with only a small quantity of soluble iron salts.

Other tests, made on low-grade pyrrhotite, showed that it was not difficult to obtain 97 per cent of the copper content soluble in acidulated water, with twelve hours roasting at 480 deg. C.

The time required to produce sulphatization of copper in an ore depends upon the means adopted for bringing hot oxidizing gases into contact with the minerals to be acted upon. It stands to reason that it will require more time to oxidize a bed of ore several inches thick, lying on a horizontal hearth, than it will the same ore showered through an oxidizing atmosphere in a rotating furnace. For this reason furnaces rotating on a horizontal axis have often been used for the purpose; but even then it has not been found practical to sulphatize quickly.

TYPES OF ROASTING FURNACE.

The various styles of furnace available for making a sulphatizing roast may be divided into three classes. (1) mechanical furnaces with horizontal hearths; (2) rotating furnaces with horizontal axis; and (3) kilns. The first two types may be further separated into reverberatories and muffles. Reverberatories in which the ore is roasted by hand have for the most part gone out of use, as they are not economical to operate.

Muffle furnaces are preferred by some from the fact that the gases resulting from combustion of the fuel used in firing are not permitted to pass over the ore. There are other advantages in employing muffles for roasting ore that is to be leached—the temperature can be better controlled and is more uniform. There are also objections to this method. For instance, as heat must be transmitted through the walls of the muffle, material which is disposed to fuse is apt to agglomerate, especially on the floors of such furnaces, as the underlying portions are the first to receive the heat and are protected from oxidation by the overlying pulp.

According to Thomas ("Metallurgie," 1904.) who instituted a number of experiments looking to the sulphatization of chalcopyrite, ordinary mechanical roasters suffice for this purpose. They also permit the use of pulp ground to moderate degrees of fineness.

With regard to roasters having horizontal hearths, in the Engineering & Mining Journal of March 21st, 1908, page 615, it is stated that in roasting a batch several tons of ore containing about 18 per cent copper and 16 per cent sulphur, the Wedge multiple-hearth furnace was able to bring the pulp down to 1.3 per cent sulphur (largely in form of sul-

phates) without the use of any extraneous fuel, notwithstanding the low sulphur content of the original ore. In roasting ore at Butte for treatment by Neill's leaching process, the sulphur content is said to have been reduced to 2 per cent by a Herreshof furnace.

As to roasters revolving on a horizontal axis, in heating chalcopyrite with exclusion of air, so as to break down its molecular structure in order that the contained copper might be extracted with solvents, Froelich recommends a revolving drum. In southern Tyrol, where leaching operations were carried on for two years, the sulphatizing roast was made in a horizontal revolving drum, externally heated.

Kilns were made use of at the Miedzianka plant, described in Mines & Methods for December, 1911, and at the Keystone mine near Globe, Arizona. In the first named instance the ore was pulverized and made into a paste with 5 per cent clay. This paste was molded into bricks which were dried by the waste gases from the kiln. The dried bricks were charged into the kiln and roasted, with careful regulation of the draft. In this manner the copper sulphide was said to be wholly oxidized, and was leachable in a solution carrying 7 per cent sulphuric acid.

At Agordo, in Italy, fine pyrites were made up into cakes with an iron sulphate solution. These cakes were dried and roasted—presumably in heaps—very little wood being required. At Freiberg, in Germany, the same process was tried; but the cakes broke up, owing, probably, to small lime content of the material used.

It is interesting to note in this connection the effect of producer gas in roasting. At a works where pyrites were used for generating sulphuretted hydrogen by passing producer-gas over them, it was found that the roasted material was brought into a condition for weathering to sulphate much more readily than when the same pyrites were roasted in heaps.

o

The unit of weight known as the carat, used for weighing precious stones, is equal to 3 1-5 grains troy. The term carat is also used to express the fineness of gold, in which connection it means one-twenty-fourth part. Pure gold is 24 carats fine. Twelve-carat gold is 12 twenty-fourths pure gold.

o

Shoveling contests at the Continental zinc mine, at Joplin, resulted in the winner filling 235 cars, each holding 2700 lb., in five and a half days, equal to 317 tons. Eighteen cents per car is paid for this work.

TIN DEPOSITS IN ALASKA

The United States uses between 40 and 50 per cent of the world's production of tin, yet American manufacturers are almost wholly dependent upon foreign mines for their supply of raw material. Alaska may make up a very small part of this deficiency, according to a report on the "Tin Resources of Alaska by Frank L. Hess, recently published as Bulletin 520-B by the United States Geological Survey.

Tin was first discovered in Alaska on Buhner Creek, Seward Peninsula, in 1900. The next year stream tin was found on Buck Creek, which is separated from Buhner Creek by a low divide. In 1903 tin oxide was found on Cassiterite Creek, a tributary of Lost River, 20 miles from Buck Creek and about 100 miles northwest of Nome. Later discoveries of stream tin were made at several other places in the territory.

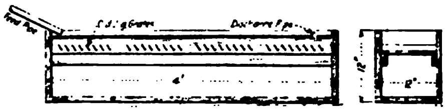
Of the tin placers none have shown much importance except those of Buck Creek. In the gravel of the creek bed the content of stream tin carrying about 65 per cent metallic tin has been found to be as high as 400 pounds per cubic yard in rich spots, though the average is under 30 pounds. In figures furnished the Geological Survey, the gold in the gravels has been estimated at 40 cents per cubic yard, at $60 per ton of stream tin, and at other amounts. Nuggets of gold valued at $20 or more have been found. When compared with the Australian and Malayan gravels, where the "black tin" content is in many places from 1½ to 5 pounds per cubic yard, the gravels of Buck Creek appear very rich, but the climate makes the conditions hard for placer working. The season is short, little or nothing can be done before June 15, and the freeze-up is apt to come by September 15. There are many storms, with cold, heavy rains, but, on the other hand, the country is very healthful. A dredge working in this district last year from September 10 to October 15 saved 92 tons of stream tin averaging 66 per cent tin, or an equivalent of 101 tons carrying 60 per cent tin, and sold for $52,000.

o

DRILL STEEL TEMPERING

In the Joplin district a unique method of tempering the drill steel is used. It is a modification of the plunging method that retains all the advantages of plunging while there seems to be little trouble from temper checking and few drill bits break off at the shank.

The method consists of using old worn-out jig grates to form a shelf to support the drill steel in the tempering tank, which is a rectangular box about 12 in. wide, 4 ft. long and 12 in. deep. This shelf is arranged so that there is from ¾ to 1¼ in. of water on top of the grates. In a few instances more than this depth of water is used over the grates, but that is not good practice as it is apt to result in breaking off of the steel at the water line. The shelf must be made of iron, for if wood were used, the hot drills would burn into the wood enough so that the bit would not be properly cooled, and a soft drill would result. A greater depth of water is used over the grates



with machine tempering than with hand work owing to the fact that it is difficult to keep the water as cool with the faster sharpening done with the machines, as when the work is done by hand.

There is a continuous feed of water going to the tank, and the amount is regulated so that by the time a drill has been put into the tank the temperature of the water is approximately at the temperature of the inflowing water. Of course the depth of the water on the grates is regulated by the overflow, which is generally a 1-in. pipe that takes the water clear out of the blacksmith shop before it discharges it.

o

In the presence of United States army officials and some other engineers, Marquis Roberto Imperiali recently exhibited near New York a new explosive, of which he is the inventor. According to a statement from the daily press, Imperiali pounded the substance between heavy hammers, melted it to a vapor in a chafing dish and heated it gradually to 400 degrees C. without causing an explosion. Afterwards, by the use of a fulminating mercury cap, he blew a 25-ton granite boulder into small pieces with 800 grams of the material. The inventor declares that only the mercury cap will cause the discharge and he asserts that the force attained is superior to that of dynamite.

o

Commenting on the "sootability" of Pittsburg, Graphite says that 40 per cent of the dust in that city is soot, and that its citizens wear plain black soots, with stripes when it rains.

o

In brazing cast iron, clean the parts to be joined, heat to a bright red, and apply a flux made by mixing the following ingredients: Boric acid, 1 lb.; potassium chloride, pulverized, 4 oz.; and 3 oz. iron carbonate.

Red Plume 700. The Sand Grass shaft is down over 500 feet and will be sent deeper. The Desert Queen shaft, controlled by the Tonopah Mining, but formerly used by the Belmont, has a depth of 1127 feet.

The Tonopah Mining produces its ore from the 700 and upper levels. The last annual report placed the available tonnage at 304,824, February 1, 1912. This was valued at $5,237,974. Mining costs for 1911 averaged $3.71 per ton, while milling costs amounted to $2.74. Marketing mill products, freight on ore, and metal losses in milling brought the total expense to $9.63 per ton. Despite the heavy costs the ore yielded a profit of $10.34 per ton. The 100-stamp Millers plant of this company has been so often described, and the method of treatment is so widely known, that details are here dispensed with.

Besides developing the Mizpah mines to a high state of efficiency, the Tonopah Mining Company has been particularly active in endeavors to increase its sphere of operations. It has been long recognized that to prolong the profitable existence of the company other properties must be acquired, and the management is constantly searching for mines of merit. In the last annual report General Manager J. E. Spurr stated that offers of mines to the company averaged about fifty per month, but out of this large number only a few propositions were deemed worthy of investigation. Several properties are being considered and the success of the company at Tonopah may result in bringing prosperity to other districts.

EXTENSION PROMISES WELL.

The Tonopah Extension is one of the deepest mines in the camp. The Pittsburg shaft is down 1150 feet, and shaft No. 1 has attained a depth of 1050 feet. The Red Rock shaft as a depth of 700 feet. Deep developments in this property have been recently very encouraging, and the company has taken its place among the regular dividend disbursers. Like many other Tonopah mines, this property was formerly considered virtually worthless, but under the stimulus of skillful and energetic management has developed into an excellent mine. It is estimated a two years' reserve of ore is exposed, with steady developments more than keeping pace with production. The mill was one of the first to embody the lessons garnered from the operations of the older Tonopah and Belmont plants at Millers, and is an excellent type of the modern Tonopah reduction plant.

After reduction in a Kennedy crusher the ore is conveyed to the mill bins by a 16-inch belt-conveyor. Suspended Challenge feeders deliver to thirty 1050-pound stamps dropping ninety-eight times per minute. The stamps are arranged ten to a battery and five to a mortar, with each battery operated by a 30-hp. Westinghouse motor preforming 690 rev. per minute. From the stamps the pulp runs to Deister concentrators, where coarse concentrates are separated and removed, and the tailings passed to Dorr classifiers. From these the coarse material is received by two 5x18-inch trunnion tube-mills. These are equipped with El Oro lining. The tube-mill pulp and slime overflow of the Dorr tables flows to hydraulic classifiers where the coarse product is removed. The slimes pass to Callow cones and the thickened pulp goes to Deister slimers. After cyaniding the pulp is filtered by Blaisdell filters and the gold and silver precipitated by the usual zinc dust process. The Tonopah Extension boasts approximately 25,000 feet of underground developments.

The New Belmont Mill, Tonopah Nevada.

SOME OF THE OTHERS.

Ranking among the highly productive and profitable mines of the camp is the Montana Tonopah. This property has been developed to a depth of 765 feet, with about 64,000 feet of underground development. The property has a recorded production of over $4,850,000, with a proven reserve calculated sufficient for over two year's operations. The mine was among the first to demonstrate its merit in the district, and has come in for particular interest during the last two years. The veins range from a few inches up to fifteen and sixteen feet in width, with values varying from high grade to medium milling quartz. As in many other Tonopah mines the veins are marked by considerable faulting, but as experience has been gained less difficulty is experienced in recovering the shoots. The shaft has three compartments and is equipped with a double-drum twin-cylinder 15x18-inch hoist, operated by compressed air and using double-deck cages. The ore is crushed in cyanide solution by forty 1050-pound stamps, and the product treated by Wilfley concentrators, Dorr classifiers and Frue vanners. From the lower concentrator floor the product passes to the cyanide plant. Final treatment is accomplished by means of Butters filters and Merrill precipitating presses.

Among the other principal mines of Tonopah, the West End, Jim Butler, Midway and MacNamara have been most largely developed. The Jim Butler has a developed area of about 25,000 feet, with seven shafts on the estate. Of these the Gold Hill is down 800 feet, while the Wandering Boy has attained a depth of 700. The Stone Cabin is down 625 feet and the Tonopah City 575. The mine has produced $315,610 and the company recently arranged for the treatment of its ore at the old Belmont mill. The Midway shaft is down 850 feet and the underground workings of the Midway mines approximates 36,000 feet. This property has produced nearly $1,275,000, with fair reserves exposed. The West End embraces three shafts, of which the deepest is the 800-foot No. 1. Underground developments approximate 25,000 feet, and the property has a recorded production of over $1,300,000. The twenty-stamp mill handles about 3100 tons of ore per month. The MacNamara developments approximate 13,500 feet. The property is equipped with a ten-stamp mill and has yielded about $1,600,000.

Two properties that are attracting considerable attention at this time are the Tonopah Merger and Halifax. In the former the intersection of a rich shoot at a depth of 940 feet recently caused intense excitement, not only because of

its seeming richness, but also because it extended the demonstrated ore zone for a total length of about 9000 feet and a width of 3600 feet. The Merger shaft is going down to the 1075-foot point. With the culmination of this work extensive lateral developments will be undertaken. The Halifax shaft is down 1400 feet and is planned to develop a large area of territory considered practically proven by the Belmont developments. Several other properties are receiving attention, noticeably the North Star, Rescue Eula, Tonopah 76, Monarch-Pittsburg Extension, Gypsy Queen, Buckeye-Belmont and two or three others.

In the recent progress of Tonopah the fairly high price of silver has played an important role. Silver represents about two-thirds of the precious metal content of Tonopah ores, and every advance in price of the white metal means a corresponding profit. Tonopah is now producing about 10,000 tons of ore per week, having an average approximate value of $270,000. With additional shipments from the Jim Butler this record will be surpassed, while other properties appear on the eve of adding their contributions to the grand total.

LAWS GOVERNING EMPLOYERS' LIABILITY

By JAS. O. CLIFFORD.*

There are few subjects provocative of greater discussion than the Employers' Liability for Accidents to Employes, which is evidenced by voluminous literature on the subect. It is manifestly impossible here to do other than to present a few important constructions of the laws relative thereto, derived from various decisions given by the supreme States' Courts, and by the supreme National Court.

In the absence of legislative enactments the relations existing between empolyers of labor and their employes, and the reciprocal duties, rights, and obligations growing out of those relations, are governed by the common law.

The English Common Law is the basis of our doctrine of Employers' Liability, but this doctrine is constantly undergoing change, both by the rulings of the States' and the National Courts, and by the enactment of numerous statutes passed with a view to a more exact definition of the rights of the employe, or to some amelioration of his condition in other respects.

The purpose of the following statements is merely to state the principles and rules of the Common Law. Of course, the reader must bear in mind that, where they have been modified or changed by legislative enactments, any rule or principle of the Common Law conflicting with a statute which has not been declared invalid or unconstitutional by the supreme National Court, it is either modified or entirely changed by the statute, in which case the statute instead of the Common Law governs.

The principles of the Common Law are differently interpreted in the various State jurisdictions, indicating merely a locally recognized view which is not in accord with the generally accepted construction of the law. The results of these circumstances have been that the statutes, where enacted, range in form and effect from a mere restatement of the Common Law, to an abrogation of it in some more or less inclusive degree.

The great volume of litigation on the subject has not affected results of a conclusive character, due, perhaps to the fact that it is largely an effort to determine the boundaries between the risks assumed under the law by the injured employe, and the unlawful negligence of the employer in causing, or permitting, dangerous conditions to exist. The definitions of these factors often have not been accurately drawn, nor have those formed been so generally accepted as to secure uniformity. Again, the view formerly prevalent favored the entire assumption of the risk by the employe, while the gradual growth of the doctrine of the duty of his protection by the empolyer has given rise to a variety of decisions and statutory enactments, with the result that the existing body of law and practice in the United States is, in effect, largely of the nature of a compromise.

DEFINITIONS.

Employer.—One who employs; one who engages or keeps in service; one who uses or engages the services of another for pay. Construing the word according to the context it may include not only a master, but also a client, a farmer, a firm, a joint-stock association, a company, or a corporation, and the like (1)

Employe.—One who works for an employer; a person working for salary or wages; a person employed; one who works for wages or salary or w
gaged in the service of anotl
whose time and skill are occ
the business of his employer;
works for another for hire;
hired to work for wages as the
may direct, and so forth. (1)

The words employer and emp
legally synonymous with the wc
ter and servant.

Relation.—The relation of
and employee is created by
either expressed or implied, wh
parties have the requisite lega
cations for entering into a v
tract. (1)

The relation exists only where
son sought to be charged as
and controls the other party to
tract of service, or espressly c
assents to the rendition of the
lar service by him. The emplo
have the right to direct the
the employe, and to either acce
ject his service. The relation
cease so long as the employe
his control, or right of control,
methods and manner of doing t
or the agencies by which it is
Furthermore the relation exis
the employe is employed, not
employer directly, but by an
in charge of a part of the e
business, with authority to enga
ance therein.

Contractor of Service.—A co
employment is one by which ar
er engages an employe to do s
for the benefit of the employer
third person, for a sufficient c
tion, either expressed or implie
narily, when an adult person so
ployment in a particular line
the solicitation carries with i
plied assertion that the one see
ployment is competent to per
ordinary duties of the position
and it is an implied condition
contract of service that the er
competent to discharge the duti
employment. (1)

Unless otherwise agreed, the
an employe must be paid in c
employer has no right to hand
vest, or in any manner apply su
whether beneficial to the em
not, but must pay them directl

**Labor Unions and Employers'
tions.**—Everyone has the right
or to refuse to work, for whom
what terms he pleases, or to
deal with whom he pleases; an
ber of persons, if they have r
ful object in view, have the
agree that they will not worl
deal with certain persons or t
will not work under a fixed
without certain conditions. T
of employes to refuse to wor

---
* Mining and Metallurgical Engineer Mills Bldg., El Paso, Texas.

or in combination except upon ions and terms satisfactory to elves, is balanced by the right of yers to refuse to engage the ser- of anyone for any reason they proper. In fact both employers employes are entitled to exercise illest liberty in entering into con- of service. (1)

EMPLOYERS' LIABILITY.

employer is ordinarily liable in ges to his employe who sustains an through the employer's negli- . Such negligence may consist in oing of something by the employer , in the exercise of ordinary care rudence, he ought not to have done, the omission of any duty or pre- n which a prudent, careful man , or ought to have taken.

two principal factors of the prob- re (1) the duty of the employer to le his employes in the discharge of duties with reasonably safe tools, nces, and work-places; and (2) the ption by the employe of the risk ed in the undertaking in which ntract of employment engages him. duty of the employer will first nsidered, but it will be found im- le to discuss it without constant- aring in mind the modifications result from the existence of the ementary obligations resting on the ye.

DUTIES OF EMPLOYERS.

eral.—The duties of an employer at he is required to use due care e safety of his employes while they gaged in the performance of their This is assumed to include all able means and precautions, the in each particular case being taken consideration. If such provisions been made as a reasonably prudent would supply if he himself were d to the dangers of the employe's n, the employer will not be of negligence. The supreme Na- Court rules, that in the case of ations, they must exercise such n and foresight as a corporation lled by careful, prudent officers to exercise. The courts have, er, condemned any instructions g to charge employers with a high- gree of care than that which may ined as ordinary; and though the re is not an absolute one, it is tioned to the dangers to which nploye is exposed. In comparison other employments mining and urgical work are, in themselves, ally dangerous. In such cases e unusual danger exists) ordinary s advanced far beyond the re- ments of less dangerous occupa-

Instrumentalities.—Important obligations of the employer are to supply tools and appliances which are reasonably safe for the intended use, and reasonably well adapted to perform the work in contemplation. Closely related is the duty to provide a safe place in which to work, although, from the many decisions rendered, the distinctions between place and appliances is not an easy one to draw.

Improvements.—The requirement in the way of improvements, or the adoption of new safety appliances, is governed largely by the usual procedure of those engaged in the same business. An employer is not bound to introduce the newest and safest appliances, but he cannot disregard all inventions for securing safety of his employes. The standard of the custom of prudent men, and the law of general usage, may compel the adoption of new devices by employers, the omission of which had not been previously considered as negligence.

The condition that an employer must safeguard his employes from exposure to unreasonable risks is subject to the general qualifications that one has the right to carry on a business which is itself dangerous, provided it does not incur liability to an employe who is capable of contracting and who knows the dangers attendant on employment in the circumstances. Briefly, the employer and employe have a right to exercise reasonable judgment and discretion in the conduct of their respective affairs.

While the doctrine does not permit the use of unreasonably dangerous appliances, nor those which are defective or obsolete, or so inferior that their adoption or retention would indicate negligence, the question is not one of comparatively safety, but reasonable safety. Consequently no fixed rule of liability is possible, each case being of necessity decided by its own merits.

Maintenance.—As in the case of furnishing safe and suitable appliances and work-places, the same care is required of the employer to maintain such appliances and work-places. If the dangers in such instances are obvious, the employe, continuing to work with a knowledge of the danger and without complaint, assumes the risk and can not recover for injuries sustained, nor will liability attach until the employer has, or could have, information of the defect requiring repair.

Customary Methods and Intended Use.—Liability attaches only where the injury is the result of the use of an appliance for the work and in the manner for which it was furnished. The practice indulged in by employes of riding belt-conveyors, mine ore-trains, ore-loaded mine cages, and other agents intended for specific uses, is subject to the action that the employe assumes the risk, and can not recover for injuries sustained. This rule is qualified by continued indugence of the practice with the employer's acquiescence. The adaption of an appliance to new uses by the employer or his representative qualifies the rule.

Closely connected with the foregoing is the rule that an employer is not liable to an employe for an injury incurred by a departure from the customary method of performing work, or by changing his place of employment to some other department, unless on instruction from a properly authorized representative.

WORKING FORCE.

Coemployes.—Various attempts have been made to lay down some rule or formula by which to determine what employes of a common employer may be said to be coemployes. While the following definitins are said to be faulty, they nevertheless give a fair idea as to whom have been determined by many courts to be coemployes, within the rule exempting employers from liability for the negligence of one of them resulting injuriously to another: (1) Persons are coemployes where they are engaged in the same common pursuit under the same control, derive authority and compensation from the same common source, and are egaged in the same general business—though it may be in different grades or departments of it—are coemployes who take the risks of each other's negligence. (1)

The principal limitations contended for on the general rule in regard to coemployes is that there is such an employe as a vice-principal who takes the place of the employer, and who is not a fellow employe with those beneath him; and there are many variations of the idea to the effect that every superior employe is a vice-principal as to those beneath him.

Whether one is acting as the representative of the employer, or merely as the fellow-employe with others employed by a common employer does not depend upon his rank or title, but upon the character of the duties he is performing at the time another employe is injured through his negligence. If at such time the offending employe was in the performance of a duty which the employer owed his employe he was not a coemploye with the one injured, but a vice-principal. The rule is fundamental that an employer can not rid himself of a duty he owes to his employes by delegating his authority to another and thus escape responsibility for neg-

ligence in the performance of such duty. If, however, at the time of injury the negligent employe was not engaged in the performance of a duty from the employer to the employe, but was discharging a duty which was due from the employe to the employer, he was a coemploye to the one injured, engaged in the same common business, and the employer would not be liable for the injuries sustained by reason of his negligence.

Duties Nondelegable.—The courts in general have held quite consistently to the view of the nondelegable quality of the duties enumerated, their rulings being that, as to employes, the employer can relieve himself only by performance. In some cases, however, it has been held that the appointment of an employe to the duty was a sufficient discharge of the obligation.

Incompetency of Coemployes.—If an employer knowingly employs or retains in his employment an incompetent employe, he is liable for an injury to his fellow-employe sustained through the incompetency of such coemploye. Of course, an employer does not warrant the competency of his employes, but he must use all ordinary care and diligence in their selection and retention. If he has not been negligent in selecting an employe and subsequently obtains knowledge of the employe's incompetency and still retains him, he is liable to all other employes for any injuries resulting from said incompetence. However, no employe is entitled to damages for any injuries resulting from said incompetence on the part of a coemploye when he knew of such incompetence and did not inform his employer of same. It must be considered, however, that neither incompetence nor unskillfulness will be presumed; they must be proved. The disqualifications of persons of suitable age may be mental moral, or physical, the most common being those that arise from the intemperate use of intoxicants, through habitual carelessness or recklessness—such as may reasonably come to the knowledge of the employer—likewise charge him with liability. A single act of negligence or incompetence of an employe is not enough to fix the employer's liability for continuing to employ the employe guilty of the same.

It is, therefore, quite apparent from the above statements that the employer must be reasonably and properly careful and diligent to see that each employe hired by him has such qualifications as will enable him to perform his duties without greater risk to himself and his coemployes than the business necessarily involves.

Rules and Warnings.—Another branch of the employer's duty is that of providing appropriate rules, and the carrying out of a suitable system for the conduct of his work. No assumption is made, however, that rules can be so arranged as to guard against every contingency.

Enforcement of rules is no less a duty than the promulgation thereof. Repeated and notorious violations will charge the employer with a knowledge of the insufficiency of the provisions made and the necessity of new regulations, or of additional superintendence. In the absence of steps to secure enforcement of rules thus violated it has been held that the employer has sanctioned their abrogation, and that they are no longer binding.

Besides the general rules by which the conduct of business is determined, instructions may be necessary either in case of abnormal conditions, or of the employment of inexperienced persons. The principle lying at the foundation of this duty is the same as in the case of providing safe appliances and safe workplaces, i. e., liability does not attach on account of the dangers of the situation, but for placing the employe in a situation of which he is inexcusably ignorant. Not every contigency is to be anticipated in the giving of instructions, but such only as are probable in the conduct of the business, and while the employe keeps within the scope of his employment.

CONTRACTS RELIEVING EMPLOYER.

Employe's Waiver of Right to Recover.—Efforts on the part of the employer to make his employes insurers of their own safety by the adoption of rules, or the requirements of contracts releasing the employer from liability will, generally, be discountenanced by the courts.

Thus it has been held that a contract executed subsequent to the employe's entrance on service, relieving the employer of liability, is void for want of consideration. On the other hand it has become more or less the custom among employers to require of an employe as a condition of employment the making of a contract relieving the employer from the liability imposed by law. In England it has been held that it is not contrary to the policy of the employers' liability act to waive the benefit of the same by contract, and that such contract is binding, not only upon the employe himself but also upon his representatives in case of death. In the United States it has generally been held by the courts that a contract made in advance, irrespective of statute, whereby an employe agrees to release and discharge his employer from liability for any injury he may receive by reason of the negligence of his employer, or of his representatives, is contrary to public policy and is, consequently, void. This principle has been announced by a national court as follows: "As a general proposition it is unquestionably true that an employer can not relieve himself from negligence by any contract entered into for that purpose before the happening of the injury."

In direct contradiction to the foregoing statement is a decision rendered in which it was held that where an employe, by special written contract made at the time he was employed, and in consideration of said employment, agreed "to take upon himself all risks connected with, or incident to, his position, and that he would in no case hold the corporation liable for any damage he might sustain by accidents which might result from the negligence, or carelessness, or misconduct of himself or other employes or persons connected with the corporation, or in the service thereof," such a contract, so far as it did not waive any criminal neglect of the corporation or its principal officers, was a legal contract and binding upon the employe, and in effect waived all his rights under the law. In other words the court held that it was legal for an employe to contract with his employer to relieve such employer of all liability in damages for injuries sustained.

Where the feature of relief benefits exist a new factor is introduced and the rulings are quite uniform in favor of the contract. In general the terms of the contract are, that the acceptance of benefits by the injured employe should operate as a waiver of his right of action at law against the employer.

RELIEF ASSOCIATIONS.

Briefly described, a relief association is an institution organized by a corporation designed to furnish money benefits, and often free hospital treatment, to employes of such corporation when they are disabled by accident or sickness, and to provide a certain sum of money for their families in event of the employes' deaths. The relief association's affairs are exclusively under the management of the corporation which contributes to its funds. In addition a certain proportion of the wages of each employe who is a member of such association is retained by the corporation and turned over to the benefit fund of the association. It has become the custom to include in the application for membership in the association the following or similar agreement on the part of the employe: "The said applicant agrees that, in consideration of the contributions of the said corporation to the

relief and hospital department, and of the guaranty by it of the payment of the benefits aforesaid, the acceptance of the benefits from the said relief and hospital department for injury or death shall operate as a release of all claims against said corporation for damages by reason of such injury or death." Many of these applications, in addition to the above agreement, contain the following: "And I, or my legal representatives, will execute such further instrument as may be necessary, formally, to evidence such acquittance."

This sort of an agreement (contained as it usually is in the printed application for membership which must be signed by each employe who desires to join such association, is evidently designed to relieve the corporation of its legal liability for damages for injuries which the employe might sustain, and at first thought seems plainly antagonistic to the principles of the Common Law and the provisions of the various statutes which prohibit contracts, and so forth, waiving the employers' liability.

Such agreements, coupled with the fact of the actual acceptance of aid from the benefit fund after receipt of injury, have frequently been set up as matter of defense in suits brought against corporations for damages for injuries. The results of the decisions of the courts of different states seems to be to hold such contracts valid. It has been generally held that while a contract by which an employer attempts to relieve himself from a future liability for injuries or death of an employe would be void as against public policy, and frequently as being in violation of statute, yet the agreements or contracts now being considered are not of that class, but are only contracts for a choice between sources of compensation for the injury, where but a single source of compensation existed prior to the making of such a contract; that such an agreement recognizes that enforceable liability may arise, and only stipulates that, if the employe shall prosecute a suit to final judgment against the corporation, he shall thereby forfeit his right of action to recover from the relief fund, and conversely. It is the final choice, the acceptance of one against the other, that gives validity to the transaction.

It will be observed that it is the acceptance of benefits from this relief fund which, by agreement, releases the corporation from a claim for damages. If the employe injured does not accept such benefits, but chooses to sue for damages, his right of action is unimpaired, and in no respect waived. It is not a question of whether a corporation, by contract with its employes, can exempt itself from suits for personal injuries sustained by its employes which were caused by its negligence; that, as a general rule, can not be done. The employe does not waive his right of action against the employer, in case the former is injured through the latter's negligence, by the execution of the contract. It is not the execution of the contract that estops the injured employe, but his acceptance of monies from the relief department on account of his injury after his cause of action against the employer, on account thereof, arises.

DEFENSE OF EMPLOYERS.

Employers can not be held as the insurers of their employes; they are liable, however, for the consequences, not of danger, but of negligence on their part in the event of a breach of duty to an employe resulting in injury to him.

Assumption of Risks.—As stated in a previous paragraph when a contract of employment is entered upon the law imports into the agreement an assumption by the employe of the ordinary risks incident to the employment, and of such other risks as may be known to and appreciated by him. This is said to be a term of the contract, expressed or implied, from the circumstances of the employment, and is commonly stated as the 'trade risk.' In this connection it might be advisable to outline the two classes of risks recognized by the judiciary and known as 'ordinary' and 'extraordinary' risks.

Ordinary Risks.—Ordinary risks have been defined as those that pertain to the employment after the employer has discharged his duty as to safe work-places, tools, appliances, and so forth, and which ordinary care on his part can well guard against.

Extraordinary Risks.—Risks which may be obviated by the exercise of reasonable care on the part of the employer are classed as extraordinary, and these the employe is held not to have assumed without a knowledge and comprehension of the dangers arising from the employer's negligence. If the dangers are patent, or are brought to the knowledge of an employe, his entering upon or remaining in service is presumed to have waived his claim against the employer for resulting damages. In the first place he will be held to have made his contract in the light of existing conditions; and, as to risks arising during employment, it has been said that if an employe continues to use a work-place, tools, appliances, and so forth, which he knows to be dangerous, he does so at his own risk, and not at that of his employer. It must appear, however, that the risk was actually appreciated. While a failure to notify the employer of discovered or known risks is construed as indicating the employe's willingness to continue to work while they exist, the risk is not thrown upon the employer by a mere notification not replied to by his promise to repair. If the alternative of continuing to work with the defective appliances, or of leaving the employment is offered, and the employe continues to work, he will be held to have assumed the risk. A promise to repair, however, can be relied upon only for a reasonable time, after which the risk will be upon the employe.

Where a specific direction from the employer, or other competent person acting as the employer's representative, ordering a temporary departure from the contractual lines of duty, the risks incident to the new employment are, in a sense, extraordinary, as the new order carries the employe beyond the contract of hiring and so, also, away from his implied undertaking as to assumed risks.

Contributory Negligence.—It is a general rule that when an employe suffers an injury through the negligence of his employer he is not entitled to recover damages for such injury if his own negligence contributed thereto. Under this rule where employes and employer have equal knowledge of the danger of the service and the means of avoiding it, and the employe, while engaged in the performance of his duties, is injured by reason of his own inattention or negligence, the employer is not liable; and, where the employe is told to do a particular thing and is not directed as to the time and manner in which the work is to be done—it being left to his discretion—he is guilty of contributory negligence if he does not use the safest means of accomplishing the work and is injured while so engaged, and cannot recover damages from the employer. But an employe's right to recover damages for an injury is not affected by his having contributed thereto unless he was at fault in so contributing. Likewise an employe is not guilty of contributory negligence if, when injured, he was exercising ordinary care to avoid injury, and discharging his duties in a careful and prudent manner, and the injury was sustained by reason of negligent failure on the part of the employer to exercise ordinary care for the employe's safety.

When a risk involves such a degree of danger that a prudent man would not assume it, the defense to an action by an inured employe is not that the plaintiff by his contract assumed the risk, but that he was, by his conduct, guilty of contributory negligence. It will be observed that the line is not closely drawn

between the two defenses, nor is it always easy to do, inasmuch as the facts in a given case might support either defense. Cooley (Torts, page 674) announces the rule as follows: "If the plaintiff, or party injured, by the exercise of ordinary care under the circumstances, might have avoided the consequence of the defendant's negligence, but did not, the case is one of mutual fault, and the law will neither cast all the consequences upon the defendant, nor will it attempt any apportionment thereof."

Contributory negligence is purely a matter of defense in action b employes' for damages resulting from injuries sustained during the course of their employment, and the burden of proving it is upon the employer who seeks thereby to avoid liability for such damages.

Comparative Negligence.—The attempt to impose a doctrine of comparative negligence has been declared unconstitutional. Primarily this doctrine favored an apportionment of the fault where, in the case of inury to an employe, if the preponderance of negligence seemed to be chargeable to the employe, to award damages in a corresponding amount. Conversely, where the negligence of the employer is great, and that of the employe but slight, the latter may recover The construction placed upon this doctrine of comparative negligence is merely a peculiar restatement of the common law doctrine of contributory negligence.

GENERAL.

The past few years have been marked by a rapid increase of interest in the question of the adjustment and distribution of the burden of the results of industrial accidents, the doctrine of compensation as distinguished from that of liability coming for the first time in the United States to any widespread support. Where the idea of the employers' liability controls, the employe is given a right of action against the employer in cases where injury from accident results as a consequence of the negligence of the employer, or of some one charged with the performance of his nondelegable duties; with this, however, the rule must be considered that where the injured employe contributed by his own negligence to cause the accident, such contributory negligence bars recovery. Ordinary risks, not due to the employer's negligence, but incidental to the employment, are held to be assumed by the employe and for injuries resulting therefrom no recovery of damages can be had. It is obvious that the only right allowed the injured employe under this doctrine is the right to sue which experience has shown to involve uncertainty, delay, expense, and the ultimate acquisition by the workman of only a fraction of the money actually expended by the employer in the way of defense and of payments on judgments.

The impossibility of securing to the workman the needed protection by a mere grant of right of action for injuries for which the employer can rightly be charged is evident from a consideration of the principles of law set forth above. The employer who is the agent of the public in the matter of production, should be charged with the duty of so administering industrial undertakings that the burden of the socalled "trade risk" shall fall on the industry at large, and not be concentrated on the weakest point—on the individual workman, disabled for service through the mere fact of his employment at the time and place of the occurrence of the inevitable accident, or on the widow and children of such workman, if the accident results fatally.

CONCLUSION.

Owing to the multiplicity of the statutes passed by the legislatures of the different states, together with the fact that they are all applied and interpreted by courts composed of many different individuals whose intellectual faculties do not all work in the same grove, and whose judgment, therefore, do not always coincide, and, also, to the further fact that in no two cases are the facts precisely the same, there is always an uncertainty as to the outcome in each particular action brought for the recovery of damages for injuries. For the above reason it is no doubt true that many cases are compromised or dropped altogether by employes rather than to incur the expense of a suit at law, and to risk the uncertain outcome thereof; and, on the other hand, many employers are put to much trouble and expense in deciding suits which never should have been brought, the employes having, as the results demonstrated, no legal case.

That this condition of affairs—this uncertainty as to whether the law affords a remedy—can ever be improved while the human intellect continues to be fallible, and the present line of legislation continues to be followed, is greatly to be doubted, and it is this fault of the law in its application which led to the radical changes in the plan of legislation which have been made by Great Britain, France, Germany, Belgium, Russia, and many other foreign countries, in their compulsory insurance acts and compensation acts against accidents to workmen.

Briefly, the idea of compensation is that of an award of a fixed sum for injuries for which the employment is responsible without the necessity of litigation, or the endeavor to determine the question of fault. It is frequen vided, however, that where an e is apparently grossly negligent, will be recoverable, and if the is willfully or grossly negligent, take nothing either by way of sation or otherwise.

Legislation upon the lines of the employer responsible for all of his employes, regardless question of the employers' neg and the system of compulsory in of the employes against accid adopted in foreign countries, given a trial in several states Union, but as yet the subject really become a national issue.

NOTATION:—(1) Cyclopaedia and Procedure.

———o———

When properly used, the ter applies to a banded variety of ch closely allied to agate. It is s siliceous rock, and constitutes th ious onyx" of the ancients. The derived from the Greek for nai lusion to the wavy bands which the stone, and to its translucen of which characteristics it has mon with the nails of the hand. the term travertine are included tintc types of rock which agree sisting of calcium carbonate, or but which have quite distinct m origin, one being deposited by the of hot springs, mainly through the of conferva-like plants, and the o ing deposited from cold waters i as a result of purely chemical These deposits are both known a tine, which is found wherever wat ly charged with calcium carbona over the surface. Much of it i porous, or cellular in structure, this phase of deposit, as found al orifices of springs, the term "t "calcareous sinter" is applied. compact in texture the rock is of taking a fine polish, and as a term for both spring and cave the term "Travertine marble" is a priate designation. It is unfortun the term "onyx" has been ap these rocks, which are essential bles.

———o———

The necessity of having the concentric is obvious. In hand ening and even with some powe eners it is not uncommon to find the ends of the cutting edges pr 1-32 to 1-16 inch beyond the other manufacturers have effectually o this difficulty by entirely enclos bit under a heavy pressure whi being forged. When this is don can be no question of the corn ing within a circle.

GEOLOGY AND MINES OF HIGH GRADE DISTRICT

By WILLIAM H. STORMS.*

High Grade mining district, which has the past few months attracted considerable attention from prospectors, and investors as well, is situated in Modoc county, California, and extends a short distance northward across the state line into Oregon. It is on the summit of the Warner range of mountains which lies between Goose lake, on the west, and Surprise valley on the east. The entire district is in a region of volcanic rock—andesite and rhyolitic flows and tuffs, forming the central portion of the range with later flows of basalt and agglomerate on the eastern borders.

The history of the district extends back for many years, but the entries are few. At one time the government maintained a military post in Surprise valley, known as Camp Bidwell This place, now called Fort Bidwell, is about twelve miles southeast from High Grade, and is near the eastern base of the Warner mountains. Soldiers from the fort, and others, found gold in the Warner range many years ago, but the principal prospector was a man named Hoag. He did considerable work at the surface on various claims, and the district came to be known by his name. In 1905 new discoveries in these mountains resulted in renewed interest in the possibilities of the region, and then, for the first time, some real development was accomplished, which has since been followed by a much more general interest in these prospects and the renaming of the district, it being now known as High Grade. It is needless to say that this newest name for an old district was suggested by commercial considerations. Nevertheless, there is high-grade ore in several mines of the district.

The geology of the district is comparatively simple when viewed in its broader features, but somewhat complicated here and there locally. The Warner mountains consist of a thick series of volcanic flows and sediments which form a portion of the great volcanic plateau which covers all of Modoc county, a large part of Shasta and Lassen counties, and extends northerly and easterly into Oregon and Nevada. The general history of the Warner range, as indicated by exposures in that region, shows that a vast mass of nearly horizontal volcanic strata, chiefly andesites, rhyolites, and tuffs, were cut by a great fault which skirts along the east shore of Goose lake. In fact, it looks as thought Goose lake were the direct result of the faulting of this region. Israel C. Russell has written a most interesting description of a number of these faults which occur in southeast Oregon and extend southward into California. Several of the valleys formed by the faulting of the great volcanic plateau are the sites of lakes; others have been filled with detritus and are now fertile valleys. Along the east side of the Goose lake fault the volcanic beds were lifted 2000 feet or more, the entire series dipping 10 to 20° to the eastward. Russell describes a similar fault along the eastern base of the Warner range in Paradise valley, so the Warner mountains as a whole represents a great fault block, lifted above the surrounding valleys, the strata having a general dip to the eastward. In the central portion of this range the rocks do not all lie so nearly flat, but are found more or less disturbed, at some places standing in vertical position. There are in the central area several minor faults which have divided the district into a number of fault blocks. It is in the vicinity of these faults that the principal mineralization has taken place, along zones of brecciation, or following fissures in the breccia, which strike in various directions, though usually north-south and east-west. Where these fissures have intersected each other there has, in some places, been an enrichment, and it is the occurrence of this rich ore that doubtless suggested to the miners the name of the district—High Grade.

There is evidence to prove that after the uplift of the range and the formation of the brecciated zones and fissures in which the gold-bearing ores are now found, there was a long period of erosion, found planed off in some localities on the as the strata of rhyolites and tuffs are higher hills, and the gentle slopes to the northeastward, which at first might easily be mistaken for dip-slopes are really the result of erosion. The theory of a period of erosion at that time is proved by the fact that the later flows of basalt and andesite with their accompanying tuffs, overlie the adjacent hills to the eastward, tongues and remnants of the basalt being found lying on the older rhyolite and tuff, which would be impossible had the upper rhyolite not been removed by erosion. These later volcanic rocks have no connection whatever with the miner-alization of the district, but it is ii ing to know that the ore-bearng tions extend eastward and northw neath the more recent volcanics admits the possibility of the exten the known mineralized zone in tha tion. I was shown some ore, a s brecciated rhyolite, from the ea of the Fort Bidwell range, that m sembled some of that found in th Grade district. For lack of tim not visit that locality. Since the of basalt flows the entire region h subjected to tremendous erosion, cated by canyons 3000 feet deep the top of the basaltic plateau.

The accompanying sketch, Fig northeast-southwest cross-section Grade district, drawn through mountain, one of the highest po the district. It will give a gener

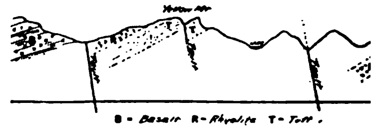


Fig. 1.—Cross-Section at High G

of the structural geology of the as a whole. The time at my was not sufficient to admit of a examination of the entire region tail, so at this time generalizatio can be submitted. The sketch m 2, shows the drainage of the count on it are also indicated some of th which appear to have important on the structural features of the and incidentally on the minerali

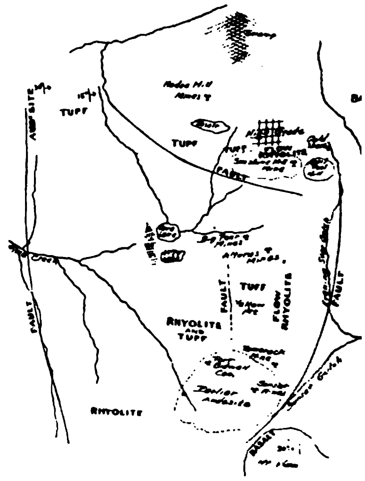


Fig. 2.—Sketch Map of the High (District.

I did not ascertain the natur cession of all of the rocks in the turbed area lying in the western the Warner range, but know tha rocks are principally white flow- and white rhyolite-tuff. These c the greater part of the front c range. About half way between t of the mountain, and High Grade I believe the rocks have been

* State Mineralogist of California in Mining & Scientific Press.

me of the rhyolite and tuff found front range appears to be repeated eastward of this fault, if it actual- ts This should be verified, as the ne may be said to be suggested by aphy rather than by actual evi-

However, about half a mile east electric light plant on Pine creek, rupt facade of purplish rhyolite several hundred feet above the bot- f the canyon, with a steep talus base. Its course is a little west th and east of south. Bluffs and of what appeared to be the same nay be seen for a distance of a and a half or more, occupying a · position on adjacent hills, and ct line with the main palisade on orth side of Pine creek. This I to be, in all probability, the main of bringing the rhyolites of the range once more to the surface in cinity of High Grade. If this fault y occurred it must have a throw ing 2500 feet

principal rocks of the High Grade t are a white flow-rhyolite at the nderlain by a bed of variable thick- of white rhyolite-tuff, usually buff l near the surface, and this in s underlain by purple porphyrite e. These rocks extend from the e northerly end of the district. they pass under the more recent , to the south end, at the Sugar and Mountain View mines of the Bidwell Consolidated group. South- rom there the rock is principally cient andesite of very fine texture, g from bluish-black to greenish- and grayish-black in color. I did e a single intrusive dike in this n of the range, though dikes of cutting the tuffs and rhyolites of Cottonwood creek are numerous. latter are five to six miles south- of this district. In that vicinity, on ear the Snyder ranch, are also fis- eins containing gold, some of them very encouraging prospects.

re are several types of ore deposit gh Grade district. The most com- re zones of brecciation, highly sili- and auriferous. These occur in hyolite and tuff, and also in the · andesite at the south end of the t. A second type is that of rather fissure veins cutting at high angles h the zones of brecciation. In some mines these fissures run at nearly angles. At the intersections rich s been found.

ird type occurs in the form of near- sheets of rhyolite or tuff, highly ed but with little or no brecciation, auriferous. These may be con- d as zones of impregnation. Still r type is the fissure vein occurring outside of any zone of extensive breccia- tion. This latter is represented in the North Star mine, where a fissure, vary- ing in size from an inch or two to three feet or more, runs through the earlier andesite. Some of this rock contains payable ore; some of it is low grade. The quartz is white and sacchaoidal, and shows some blue and green copper car- bonate. This is said to be the discovery vein of the district. It is developed by several hundred feet of workings. It is at present held under lease and option.

The Sunset workings, consisting of about 800 feet of development, are en- tirely in the earlier andesite, which here is found sheeted by pressure, the struc- ture making it appear like a nearly ver- tical dike, or intrusion. I think that a fault of considerable displacement passes just east and south of this locality, its course being denoted by the neighboring canyons, Evening Star gulch and Sunset gulch. On the opposite side of this can- yon and about 100 feet south of the Sun- shine mine, the basaltic strata of Mount Vida are seen to have a northwesterly dip, which is opposite to the general dip of the formation to the northward. This fact appears to lend color to the probable existence of the fault here referred to. This fault has a curving strike the con- cave side facing the west. Unfortunate- ly, at the several points where these faults pass through low saddles, in every instance examined, the evidence of their existence is obscured by low flat sur- faces, covered by deep soil, or piles of rock.

The Fort Bidwell Consolidated prop- erty comprises several claims. The Mountain View, one of these, occurs in a zone of breccia at the contact of the earlier andesite with the rhyolites, whereas the Sugar Pine, another of its properties, is wholly is the rhyolite.

The Shasta View, adjoining the Moun- tain View on the southwest, is wholly in the earlier andesite. Both of these properties have some high-grade ore, and much that is too low in value to ship, but which is still a good grade of milling ore.

The Fort Bidwell company is operat- ing a 10-stamp mill. The ore is deliv- ered to the mill from the Mountain Vew by drift and tramway on the mill- level, and from the Sugar Pine, which is on the opposite side of the divide, by aerial rope-way. The workings of these two claims are to be connected, when all ore can be sent to mill through the main adit, which will prove a great advantage, as the deep snow in winter interferes with the operation of the rope- way.

The Alturas company's property is on the east slope of Yellow mountain, and is wholly in the rhyolite. The principal shaft is 105 ft. deep. Hoisting is done with a horse-whim. In this shaft a shoot of ore in purple flow-rhyolite is being developed. This ore contains more sul- phide (pyrite) than was observed in any other mine in the district. Yellow mountan slopes from its crest, at 10 to 15 deg. eastward for a distance of a mile, when it plunges steeply downward into Evening Star gulch. Along the rim of this sudden descent, and on the flat back of it, are a number of promising pros- pects. Some of these belong to the Alturas company, others to the Seven Lakes company, while still others are held by the locators. Among these lat- ter is the Dandy Fraction, which makes an encouraging surface showing. These workings are mostly in the brecciated flow-rhyolite, though a few are in the tuff. Some of them are of the impreg- nation type. On the northeast side of this rim considerable work has been done on a claim called the Mountain Sheep, but the mine is idle, due to pend- ing litigation. The cause of the conten- tion lies in the fact that the Mountain Sheep conflicts with three other loca- tions, having been laid diagonally across them.

To the eastward of Yellow mountain and between it and Camp High Grade is the property of the Big Four company. The ore deposits here are of several types, including practically all of those found in the district. One of these is that of a flat sheet of much silicified rhy- olite which shows little evidence of brec- ciation. This ore is being treated in the company's 5-stamp mill, with good re- sults, so I was informed. In this prop- erty considerable work has also been done on a nearly vertical fissure vein, in which high-grade ore was found.

The Sunshine, Yellow Jacket, and Last Dollar mines are on Sunshine hill and are practically in the camp of High Grade. The ore here occurs mostly in brecciated masses of rhyolite with north- south and east-west fissures cutting the zones of brecciation. It is at the in- tersection of these fissures that the rich ore has been found. The first shipment of 10 tons carried over $250 per ton gross value. Another shipment was ready at the time of my visit. On the Sunshine hill there are at least three separate zones of brecciation, and there may be others not as yet developed. The Sunshine claim has been divided into a number of blocks, nearly all of which had been leased, and the lessees were eagerly working to develop their several holdings. To the eastward on a neigh- boring hill the Gold Shore claim resem- bles the Sunshine, having the same rhyo- lite breccia and silicification, which is an

accompaniment of the auriferous ores of profitable grade everywhere in this district.

On the plateau north of High Grade is a group of claims owned by the Modoc Mines Co. A shaft had been sunk to a depth of 60 ft. at the time of my visit and some excellent ore found. The ore here is in the brecciated rhyolite. This company has built a substantial headframe and has a well equipped steam-hoist.

There are numerous other claims scattered throughout the district, but which had so little development that no particular mention is made of them, though some of these show good prospects in gold. I observed fissures in various parts of the district, in which the rock was much kaolinized and stained by iron oxide, but all of the occurrences of this character that came to my attention were low in gold. There may be exceptions to this, but I did not see them, if there are any.

There are some striking features in the topography of this district, which are due principally to two causes, first, minor faulting, and second, climatic conditions. Naturally the first cause has left the more noticeable results as observed in the steep slopes on one side of the hills which are probably fault scarps modified by erosion. There is undoubted evidence of the former presence of small glaciers, as indicated by the kames, moraines, small lakes, and swamp holes, in the canyons of the region. Cave lake, Lilly lake, Opal lake and others are all of this origin. Since the glacial period erosion has progressed so far as to destroy practically all evidence of its former existence except the features above described.

Another pronounced feature in the topography is in the so-called "rock piles." These are generally the locus of ore disposition. All the ore of the camp so far as I observed, is extremely silicious. The already dense rhyolites, in the zones of fracture and brecciation, have been rendered additionally hard by the infiltration of silica, and these zones being more resistant to erosion have a tendency to stand up in wall-like masses above the surface. These walls have been attacked by alternations of freezing and thawing, and the result is, as seen, a breaking down of these hard outcrops and the scattering of the fragments, large and small, over a considerable area in the immediate vicinity of each occurrence. This has made the development of the ore-bodies rather backward, as so much superficial work was required and is still being done to find the gold-bearing rock in place. The prospector first finds "float" ore in the pile of loose boulders. He then decides, as well as he can, upon the most likely point to find the orebody in place. The loose rock is often from 10 to 30 ft. in thickness and it requires considerable preliminary work to reach solid rock. In most places an adit run from some place on the mountain side would best solve the problem, but these lessees want to find their ore and stay with it, which from their point of view, is good policy. Owing to these peculiarities, the hardness of the rock, shortness of the summer season, and lack of present liberal financial aid, it will probably be another year before much more is known of the geological conditions obtaining in this district, than is indicated in this description, for the work of development will proceed slowly at first.

The metallurgical problem is not a difficult one. At present, simple amalgamation is the only treatment given these ores, but the percentage of value thus saved is sometimes discouraging. The gold is extremely fine in most of the ore, though the richest ores occasionally contain much visible gold. I believe that the cyanide process will satisfactorily solve the metallurgical difficulties. The only sulphide observed was pyrite, with a single exception, which was an occurrence of mispickel. Copper also occurs in a few places, but in small amount. Generally speaking, so far as developed, iron sulphide is far from abundant in these mines, the gold appearing to be associated rather with the secondary silica than with sulphides of the base metals. Most of the gold is accompanied by silver, some of the bullion running as low as $12 per ounce. Most of the ore affords excellent examples of that condition so interestingly described by Franz Posepsy as "crustification."

The district is an ideal summer camp. It has the advantage of abundant timber and water, and is but nine miles from the railroad, at New Pine Creek. Deep Creek, which heads just north of High Grade will furnish abundant power which can be transmitted into the district. So, on the whole, High Grade may be said to possess the elements of success. The energetic men who are at present interested in the district, and who, by the way, are mostly from Colorado, where they do not look upon the deep snow of winter as an insurmountable obstacle, will, without doubt, make the most of the situation at High Grade and achieve the success to which they are entitled. At present there are no saloons in High Grade, and little or no gambling, nor is there either church or school, but the people of the camp are optimistic to a degree, and most of them have calloused hands, which speaks much for their faith. A portion of the district—that at the north end, is on "school land," section 36, which was purchased from the state. The rest of it is in the forest reserve.

It has bees repeatedly stated by some of those interested, that High Grade district is "another Cripple Creek," and that "it will eclipse Goldfield." These and similar comparisons with noted mining districts have been made. Geologically it bears no resemblance to either Cripple Creek or Goldfield. The mineral deposits are only in a remote way similar to those of Goldfield, and very unlike those of Cripple Creek. Each mining district must stand or fall upon its own intrinsic merit. High Grade will, without doubt, produce some profitable mines, but how many remains to be determined by development and ore treatment. Already the newspapers are beginning to contain statements attributed to me, which I never uttered. The above description of the camp is a truthful one, and presents the district to the mining world as I saw it during my visit of a few days. The work was a reconnaissance at best, and the statements made are subject to change as development proceeds and the district becomes better known.

That every claim, or group of claims, in High Grade district will become profitable, I do not believe, but the superficial showing certainly justifies energetic prospecting and that, too, in some places where little has as yet been done. There is a probability that the development of the surrounding country will extend southward to Mount Vida and beyond, and some encouragemest has already been given prospectors in that direction. I did not visit that locality, however, and know of it only from the description of those interested there, who showed me some ore which they said came from that locality.

———o———

Pumps often give trouble because of an unequal pressure within the steam-chest acting on the area of the steam valve or the valve stem. As the valve stem extends through only one side of the steam chest there is a constant tendency to blow it out. To overcome this trouble the use of a coil spring between the bracket and collar has been recommended. This spring should be given sufficient tension to counter balance the action of the steam acting on the area of the valve stem. While the action of the steam is to force the valve stem out of the chest, the spring forces it in again and therefore the forces are neutralized and the valve stem stays where it is left by the tappet arm.

———o———

The tungstate of manganese is known as huebnerite.

Mines and Methods

Vol. 4; No. 8 SALT LAKE CITY, UTAH, APRIL, 1913 Every Month

Mines and Methods

Issued Monthly by the MINES AND METHODS PUBLISHING COMPANY, Offices 306 Tribune Building, Salt Lake City, Utah, U. S. A.

SUBSCRIPTION RATES

Single Copies 10c
By the Year $1.00

Applicable to United States Possessions, Cuba and Mexico

CONTENTS:

"Spieler" for the "Commercial Club" excursion to Bingham: "Ladies and gentlemen: We have now arrived at the 'greatest copper camp on earth.' On your right is the workings of the Utah Copper Company. You came here, no doubt, expecting to see how the steam shovels operate on the 'ore,' 'near ore' and 'waste' that is mined and hauled to the mills of the company at Garfield and converted largely into tailings. Were it not for this high board fence and the army of 'fighting deputy sheriffs' which guard the gates and all approaches to the property for fear that a representative of Mines and Methods might slip through, we should be glad to have you all see this magnificent, shimmering mountain of copper ore in all its splendor and dazzling brilliancy of color; but, for the reason stated, you will have to content yourselves with whatever peek through the knot-holes of the fence you may be able to obtain unobserved by the deputies. Then we shall get ready for the return trip."

The Pending Crisis In Utah Copper

For several months past the subsidized press of the Utah Copper Company have made frequent comment on the fact that the Nevada Consolidated Company has, in the working of larger quantities of low-grade ore, demonstrated that a good profit can be made on ores containing no more than one per cent copper. In fact it was said that ores containing as low as eight-tenths of one per cent copper had been treated at a profit by that company. These facts were also mentioned by Manager Jackling with the evident intent of impressing the public with the perfection of the methods and processes by which ores are mined and treated at the several properties under his management, and also, to avoid any shock which might result from his late announcement that upon the properties of the Utah Company, it has been found that a large portion of material which had theretofore been regarded as capping, and which contained one per cent copper and less had, during the period covered by the last quarterly report, been sent to the mills and treated with satisfactory results. In fact, the report showed that the entire tonnage of ore sent to the mill for the period covered, contained barely one per cent copper.

We have already shown how the tonnage of the Utah Copper has been increased from time to time by including in the estimates neglected quantities of comparatively barren rock, and how, to afford justification for the continued use of steam shovels, the stripping on Boston-Utah ground, which had become of a thickness of some two hundred feet, and therefore impossible of economical stripping, had been in the later estimates of ore reserves, sliced off from the bottom and added to the vast sum of three hundred million tons of ore theretofore reported But, with all their juggling with facts and conditions, the Utah management, through its press, has deftly contrived to make it appear that the large bodies of high-grade ores, of which so much was said in earlier reports, still remain untouched and to be drawn upon at convenience when these low-grade rocks shall have been disposed of, thereby affording easy access to the high-grade reserves which are to be drawn upon for dividends when market conditions shall justify pegging the price of Utah shares at a higher level.

But the cold facts are that, as frequently shown by this journal, the higher grade ores have from the first been drawn upon by underground burrowing until every available vestige of such ores has disappeared; the result being—as must have been noted by all readers of Utah reports—a persistent dimunition in the copper content of the rock treated, until the best of that remaining, of which there is doubtless a very large volume, contains barely one per cent, or twenty pounds of copper per ton, and that overlain by some 200 feet of absolutely worthless rock which must be removed if the steam shovel folly is to be continued. Of course, as we have also previously shown with respect to the high grade ores, no possible profit can possibly be derived from the mining and treatment of ores of this grade by the Utah company, if its former methods are to be continued. Whenever the real facts shall have been exposed it will be shown that for the past six months there has been an actual loss of at least two and a half cents upon every pound of copper produced by the Utah company.

It was given out by the manager and the press that from a short time prior to the first of March operations had reached the normal production of 20,000 tons per day, or 620,000 tons for the month of March; in fact, it has been said that as much as 25,000 tons per day was handled for a portion of the month, it being understood at all times that a sufficient excess over the tonnage reported—to cover the moisture, depreciation and metallic contents—is always included, if not understood.

Reports just received from the eastern offices show that the production of copper in concentrates for the month of March was a little over eight million pounds which, divided by the tonnage treated, gives a gross yield of about thirteen pounds per ton of ore as compared to a yield of about twenty-one pounds as shown by the annual report for the year 1911—a deficit in the production for the

month of March, this year, of about eight pounds of copper per ton of ore—and in value, about $1.20 per ton. The reputed net yield from all sources for the Utah plant for the year 1911 shows an apparent profit of about 90 cents per ton of ore treated, all of which, with an addition of thirty cents a ton, would have been wiped out had the yield of copper been thirteen pounds per ton for the month of March instead of twenty-one pounds as reported for the year 1911, or a direct loss in addition to all the ore treated of thirty cents per ton, being $186,000 for the month.

When we come to consider that notwithstanding the purported large earnings and payment of dividends during previous years, when operating upon a higher grade ore, the company is now struggling with a floating debt of some $8,000,000, what must be the condition of the company's exchequer if present methods and conditions be continued a few years longer, we leave to the conjecture of shareholders.

We are quite willing to concede that the result of operations on low grade ores by the Nevada Consolidated, as reported, are perfectly feasible and credible, but conditions and the direct management at the Nevada Consolidated—the operations of its mines and mills—are very different from those that obtain at the Utah plant, and that ores of the Utah containing even eight-tenths of one per cent, with honest and intelligent methods of mining and treatment, and with copper at thirteen or fourteen cents a pound, should afford a fair margin of profit.

And now that the immediate burden of operating this vast property has, by the retirement of Manager Jackling, fallen upon the shoulders of Assistant-manager Gemmel, and in view of the fact that all efforts to market the shares by deceptive methods have failed, the paramount question now is, will Mr. Gemmel be permitted to meet the situation man-fashion, and adopt at once intelligent and sane methods of mining and treatment of these vast bodies of misrepresented, but yet commercially valuable ores.

Speaking for Mr. Gemmel personally, we do not hesitate to say that if he fails in this crisis, it will not be because he does not know the only and better way, for he is not only a capable and practical engineer, but, withal, a conscientious and intelligent gentleman.

In a descriptive article on the mines and prospects of Mason Valley we read that "this vein is a fissure in gray, crystalized lime, which constitutes the hanging wall." Good.

THE TARIFF ON LEAD

Our friends of the Commercial Club have permitted themselves to be lashed into a high state of frenzy by a number of well-meaning but grossly misguided and misused gentlemen, who have come to believe that the lead and precious metal-mining industries are greatly imperiled by the reduction in the tariff on lead, proposed by the pending Democratic tariff-revision measure. We beg our friends to possess their souls in patience and to consider in a broad light, and practical sense, what would be the possible and real effect upon these great industries should this measure actually become a law, as in all human probability it will notwithstanding the most strenuous efforts of our friends to the contrary.

The bill provides a duty of half a cent a pound upon the lead contents of ores imported into the United States, which a moment's consideration, we think, will afford ample protection against any possible importation of ores of that character, as any lead brought in in this form would necessarily be involved in a cost of at least one cent a pound before it could be put in condition to compete in the market with lead in pigs and bars. Besides, with no lead coming from British Columbia, and a premium in that country upon its production, and with smelting plants in Mexico which take care of all the production of that region, anything in the form of pigs or any possible importation of stray lots of lead ore may at once be dismissed as negligible in quantity.

In the matter of the importation of lead in pigs and bars, the bill provides an ad valorem tax of twenty-five per cent which, in view of the fact that for years the price of lead had been maintained in this country practically at and above four cents a pound, it will be seen at a glance that the duty would be at least one cent per pound and more; so that no foreign lead could be marketed at less than five cents per pound and to which, of course, must be added costs of transportation, commission, and so forth. Of course, if the price should rise higher in this country, the ratio of the tax would increase proportionately.

Now, in view of the fact that the difference between the price of lead in bars between this and foreign markets has for years ranged at and above one-half cent per pound, and was, during the latter part of last year, and January of this year, one-half cent a pound higher in London than in New York; and in view of the further fact that all lead producers in foreign regions have been greatly depleted, it certainly seems that the proposed rate would afford ample protection to our home producers. In this connection it may be pertinent to observe that the paramount peril to the lead-mining industry of the United States, and the world abroad for that matter, lies in the absolute control of the lead production of the United States and Mexico by the Guggenheims, through the National Lead Company, or lead trust.

It will be remembered that about the time of the meeting of the last Congress, and as notice to their country as to what would happen if there should be any interference by Congress with the tariff on lead, Mr. Daniel Guggenheim, head of the lead trust, from a clear industrial sky, announced a cut of thirty cents per hundred pounds on lead which he followed up by further cuts amounting in all to about sixty cents per hundred pounds, which brought the price in New York to a point about fifty cents below the market in London. If our friends will direct their attention to an investigation of the lead trust, and of the American Smelting & Refining Company, their efforts will have some show of bearing fruit advantageous to the industry they are seeking to conserve.

J. C. Dick, a local mining engineer formerly in the employ of the Utah Copper Company, returned from a trip to the properties of the Alaska Gold Mines Company a few days ago, and the newspapers were glad to get an expression from such a "disinterested" source. Mr. Dick was quoted as saying that he found conditions even better than has been reported. He found the ledge to be all of 300 feet wide, instead of the seventy feet originally claimed and he also reported that they were getting ore in the Sheep Creek tunnel, also. This would indicate that the "vein" is all of 6300 feet wide instead of 300 and it will aid materially in the tacking on of several hundred million tons of newly developed ore when the management gets ready to make another try to filch a few million dollars from the public. Mr. Dick is a pretty busy man and it was good of him to go up and undertake to clear up the situation and breathe new life into the corpse. But it won't work, Jim! We even doubt if the Guggenheim vultures will attempt to feed on that carcass.

It is now about a month and half since the Commercial Club decided to undertake a solution of the smoke and fume problem and appointed a special committee for that purpose. If anything has happened since we have not heard of it. The newspapers—beg pardon—the daily press seem to have forgotten all about the "official" investigation demanded a few weeks ago. What's the matter?

Federal Mining Report Shows Up Guggenheims

The report of operations of Federal Mining and Smelting company for the first six months of the present fiscal year (September 1, 1912 to February 28, 1913) signed by its secretary, Mr. Frank Sweeny, and sent to the stockholders, merely emphasizes the extent of the continuous loss sustained by stockholders through its contract with the American Smelting and Refining Company which minority interests are now seeking to annul as fraudulent and which was made when the Federal Company was, as it still is, controlled by the smelting company and when the latter company was in fact both contracting parties.

Assuming the figures in the report are correct and that production has been maintained at last year's average of approximately 10,000 tons of ore and concentrates a month, containing an average, as last year, of 42% lead, it is evident that about 22,680 tons of lead have been produced in six months after allowing usual deduction of 10% for "smelting loss" The average price of lead from September 1, 1912 to February 28, 1913 was \$4.614 per 100 lbs. or 23c higher than the average quoted in the company's last annual report.

This does not agree with the statement in the Secretary's report that "earnings were made in spite of the prevailing low price of lead." The report also fails to mention that the average price of silver for the same period was 62.881c per ounce, as compared with 58c recorded in the last annual report. This would account for added earnings of approximately 95c per ton of ore, or roughly \$9,500 per month.

But, instead of receiving the price for lead above quoted, the Federal Company, under provisions of its smelting contract, only received \$3.94, or 67c per 100 lbs less than the average price of lead, or no less than \$5.06 per ton of ore and concentrates shipped. This means that on 60,000 tons produced in the six months covered by the report, the controlling trust has paid for the product shipped it by the Federal Company over \$300,000 less than its market value, in addition to taking a smelting charge of \$8 per ton, amounting to \$480,000. Other producers in the vicinity of the Federal Company enjoy a freight rate to smelting points as low as \$8 a ton, but Federal is, by the terms of the contract, to pay a of \$7.15 for the privilege of doing business with the Guggenheims, although the greater portion of the product is shipped to a point where the freight is \$2.75 per ton.

Summed up, if Federal enjoyed such a contract as that granted by the same trust to the Hercules Mine (controlled by the family of Harry L Day, president and general manager of Federal, who also draws a salary of \$15,000 from stockholders) its six months' earnings would have been \$892,600, instead of \$520, 000 as reported by Secretary Sweeny. This is at the rate of \$1,785,200 a year, or 10% on preferred stock and a surplus of \$585,200. Put in another way, if Federal received full value for its lead product, its honest earnings would provide full 7% dividends on its \$12,000,000 preferred stock, full 10% on its \$6,000,000 common stock and still leave a surplus of \$345,000. This does not take into account the juggling of freight rates.

The world's visible supply of lead is running short and there is no question in the mind of any man acquainted with the real situation that, tariff or no tariff, the price will advance materially in the next few years, although it may be artificially depressed for a time by the Guggenheim interests using the bugaboo of the reduction of the tariff for that purpose.

Remembering that this unholy Federal contract has still seventeen years to run, stockholders can easily figure for themselves the extent of the iniquity practiced by the American Smelting and Refining Company, the controlling interest, and the enormous amount of which they will have been deprived at the end of the contract period. Their money is now being used to insure this result. They can also understand the tremendous importance of this contract in its bearing upon the trust's domination of the lead market of the United States.

SIDNEY NORMAN,
On behalf of minority stockholders

In addition to depicting clearly the tremendous losses that the shareholders of the Federal Mining and Smelting Company must sustain for the next seventeen years if the present smelting contract is not annulled, Mr. Norman's letter makes reference to another matter that it would be well for those who predicting dire disaster in case the tariff on lead is removed by Congress, to think about. The Federal Mining Company is one of the largest lead producers in this country and it is certain that Mr. Norman, as a stockholder in that company, would not make the statement he does above if he thought for a moment there was danger of ruining the lead-producing business by tariff revision, other than through artificial depression of the price by the Guggenheims for political effect. Backed by such outrageous contracts as that being enforced against the Federal Mining Company, the lead smelting trust—the Guggenheims—can well afford to spend some money in playing the political end of the game for the temporary effect it may have, because the producer is made to "pay the freight" anyhow.

BREAKING THE CAPPING

If steam shovel mining is to be continued at the Utah Copper, we beg to call the attention of the new manager, R. C. Gemmel, to a statement found in Mr. Jackling's report dated January 24, 1908, page 14, in which he says: "THERE ARE SOME ADVANTAGES IN CONTINUING UNDERGROUND MINING OPERATIONS IN SOME PORTIONS OF THE PROPERTY, BECAUSE THE ORE MINED IN THIS WAY IS TAKEN FROM THE OREBODIES LYING DIRECTLY BENEATH THE CAPPING, RESULTING IN THE CAPPING CAVING INTO THE OPEN STOPES AND BREAKING ITSELF, SO THAT IT IS NOT NECESSARY TO BLAST IT FOR STEAM SHOVELING"

The great advantage of the method mentioned by Mr. Jackling (in that it avoids the very great expense which would otherwise be involved in the drilling, and blasting the capping with powder) will doubtless be apparent to Manager Gemmel. We simply call the attention of Mr. Gemmel to ex-Manager Jackling's wise method of breaking down capping in order to justify the suggestion that, inasmuch as the ore has been—by underground mining methods—entirely removed from the property on the east side of the canyon, and the caving in and breaking up of the capping in that entire area having been completed, rendering it in the highest degree susceptible of removal by steam shovels, that the shovels now operating on the west side of the canyon, preparatory to securing ore, (and which work is attended with great expense in breaking down capping by blasting) be removed to the east side where the ground already is prepared in a manner to afford the advantages in steam shoveling

contemplated in the statement of Manager Jackling. In the meantime, underground working could be pushed on the west side until the capping there would be compelled to break itself in the open stopes, preparatory to future steam shovel mining operations.

SWAMPED BY TAILINGS

When locating the proposed site for the great Garfield-Magna, Utah Copper, concentrating plants, the ground was visited by the directors and others interested in the property and some mild criticism was offered by a member of the party concerning the flat character of the ground selected by Mr. Jackling, on which the proposed structure was to be erected. Vice-president Wall suggested that the mill be placed on the side of the mountain, one or two hundred feet higher, in order to secure the advantage of gravity in handling the ores through the mill, and also to insure ample dump room for the deposition of the enormous quantity of tailings which would result from the treatment of the ores of the great deposit, and to which Mr. Jackling replied: "I want to build my mill on level ground, and I would rather pump my tailings than pump my water." It now appears that the accumulation of tailings has been such as to already encroach upon the railroad used for removing the concentrates from the plant, and they even threaten to engulf the lower floors of the mill. To avoid this calamity it appears that large quantities of stripping material is being hauled from the mines, over the Bingham & Garfield Railroad, and dumped so as to form a levee, or dyke, between the mill and the railroad tracks, and thus check the encroachment of the tailings. In this connection we beg to suggest to Manager Gemmel that he adopt the wise suggestion of Manager Jackling and at once install a series of units of sand pumps in order to turn the tide of tailings in the direction of Great Salt Lake. We recommend that the units be so placed as to permit the addition of other units as the capacity of the mill may be enlarged to meet the ever-increasing volume of ore at the mines.

CHINO DIVIDEND IN PARIS

It is little wonder that the Frenchmen have recently been hurling back to America the Chino shares they were inveigled into buying in the belief that the company was on a dividend-paying basis. The scheme worked upon them was, according to the following, from the New York Times Annalist of Monday, April 14, a fine example of sharp practice—to be charitable in expression—and it illustrates perfectly to what extent the company's sponsers in this country will go in order to find a market on which to unload. Just think of a company representing itself as being on a dividend basis abroad months ahead of the time when it begins PROMISING to pay at home. But let the Annalist explain to you how the "shell game" has been manipulated:

> On Feb. 10 The Annalist printed in its Paris cable a statement to the effect that the Chino Copper Company was expected either to reduce or discontinue the dividend on its stock. This, the Paris correspondent said, was the reason for the weakness of the Chino shares on the Paris market that week.
>
> Various adept writers on mining topics in New York and Boston made sport of this news, and asked if it could be true that neither the mining editor nor the Paris correspondent of The Annalist knew that Chino Copper stock never paid a dividend. The Boston News Bureau commented disagreeably upon what it assumed to be a journalistic blunder, said it was a brilliant example of going away from home to get the news, and indignantly called upon The Annalist to dismiss the misinformed Paris correspondent.
>
> It will, therefore, be news to all of them that Chino Copper has been regarded in Paris as a dividend-paying stock from the beginning, has always been quoted as such on the Exchanges, and made at the outset a distribution which every one was led to call a dividend.
>
> That is to say, on the introduction of Chino Copper to the Paris market the first buyers cashed a premium of 1.25 francs per five-dollar share. Thereafter the shares were officially quoted as "Coupon No. 1 stamped for installment dividend paid," or "Coupon No. 1 detached."
>
> On March 3, which was nearly a month later than the Paris correspondent's cable to The Annalist, the following paragraph of information appeared in the financial columns of the Paris papers:
>
> "The Directors of Chino Copper have postponed the declaration of their dividend. This step was rendered necessary by the inability of the company to meet the amount of the dividend coupon, having insufficient funds for that purpose, in consequence of having been unable to market its entire output of copper."
>
> On March 20, Le Globe, in one of its financial paragraphs, called attention to the fact that a dividend rumor about Ray Copper had failed to affect the stocks favorably and surmised that people were too easily reminded of what had happened in Chino Copper, where, after having led every one to expect a dividend, the company deferred the payment thereon. Although the Chino shares dealt in in Paris and here are identical in every other respect, those dealt in in Paris were from the beginning referred to as dividend-paying shares. It was perhaps intended that they should be so regarded.

J. M. Bruce is the name of the man who has been sent out from the Missouri lead-zinc mines to take charge at the Butte & Superior and see what he can do with it. Eastern "financial" papers (spare the name) state that Mr. Bruce relieves Max Atwater—which he don't. He relieves Allan H. Rodgers, who is reported to have become so disgusted with the entire Utah Copper crowd and its methods of "cooking things up" that he could not, and would not, stand for it any longer. We do not know Mr. Bruce, but our heartfelt sympathies go out to him.

DALY WEST LEAD RECOVERIES

The Salt Lake Mining Review of March 30 contains the following editorial paragraph:

> Mill Superintendent Sherman, of the Daly West Mining Company, operating in the Park City district of this State, reports that the actual saving in lead values for the past fiscal year was 98.7 per cent. To the best of our knowledge, this is a most unheard of recovery in the milling of lead ores, and has never been equaled or approached.

The writer's memory is either failing or else he has not paid much attention to the contents of Daly West annual reports. The record mentioned is so commonplace at the Daly West as to have long since ceased to cause even passing comment. In December, 1909, in an article dealing with the merging maneuvering of the Daly West company, we took occasion to show what a perfect master of the business of ore concentration Mr. Sherman was, and among other things said:

> These statements show that at no time during a period of several years has the recovery of the lead contents of the ore fallen as low as 98% and seldom below 99½%. The mill superintendent's report for 1908, page 12, says: "The average assay value of the tailings was 0.02 of 1% Pb. (meaning lead), * * * while the actual saving, based on the value of the concentrates sold, was 99.8% of the Pb.," or lead contents of the ore.
>
> To illustrate the extraordinary character of this work, the report states that "original contents of lead in the ore was 4.71%," equal to 94.2 lb. per ton of ore, of which 94.01 lb. were recovered, the loss being a little less than 0.19 of a pound, or about three ounces of lead per ton of ore treated—barely enough to supply a single charge of a shotgun.
>
> And such statements as these have been annually handed to stockholders by the management for several years past. At the same time from three to five groups of men, averaging in all probably twelve men daily, working with the most crude appliances, have been constantly engaged collecting and rewashing the tailings as they flow down the canyon from the company's mill, and all are said to make wages ranging from \$3 to \$8 per man per day—and all this derived exclusively from a recovery of portions of the three ounces of lead per ton shown by the official reports of the company to have been lost in the concentration of its ores.
>
> These results appear all the more remarkable when it is understood that when the company's mill was operated at full capacity the loss of lead (Pb. as the mill superintendent puts it) did not exceed 75 lb. per day, and worth, less standard deductions, about \$1.60. From all of which it must be inferred that those technically untrained gleaners of the tail-race, with the primitive methods employed, have surpassed in efficiency the most modern appliances of the age—or that the management is indulging in coarse deception.

And we might add that the working over of the tailings from the creek below the mill is still (in season) carried on presumably just as profitably as ever. And it may be observed that one of the leasers during all this time,—and at the present,—has paid and continues to pay \$50 per month for the privilege of operating his primitive machines upon lands owned by others, over a portion of which the tailings flow, after having been discharged from the company's mill. It may also be added that this operator is at the head of the line of the retreating plants.

Guggenheims Want $15,000,000 from Public

The announcement that the Guggenheims are preparing to offer the investing public an opportunity to supply the needed capital for the recently organized Chuquicamata Copper Company of Chile, S. A., is worthy of more than passing notice, inasmuch as the plan of financing the proposition is in strict keeping with the practice of these promoters in all similar projects with which they have had to do in the past.

The new company will absorb the mining properties formerly owned, and partially developed, by the Chilian Exploration Company. The capitalization of the new company is stated to be $110,000,000, divided into $25 shares. Of this capital stock $15,000,000 will be held for the conversion, at par, of a $15,000,000 convertible bond issue bearing interest at 7% annually. The remainder of the capital stock, $95,000,000, will be retained by the Guggenheims and affiliated interests. Only the convertible bond issue will be offered the investing public for subscription

This proposed $15,000,000 bond issue will afford the sponsors of the project a return of their original expenditure of $2,500,000, and, after setting aside the $7,000,000 said to be necessary for mill and other equipment purposes, will provide a cash reserve of $5,500,000. Thus it will be seen that the Guggenheims do not for a minute contemplate a direct investment for themselves. What they have accomplished in past instances is evidently proposed in the present flotation. The initial expenditure (absolutely in the nature of a temporary loan) of $2,500,000 was made only for the purpose of preparing the property for financing, and not as an investment. The main object throughout has been to exploit the property, then finance it with money furnished by the investing public (which financing would return the amount of the temporary expenditure, in adidtion to tremendous profits resulting from stock-market manipulations), and to retain control of the property without having directly invested a dollar. The plan proposed, if carefully studied, will make the matter clear.

To those conversant with the physical operation of large properties the capital requirements of even $15,000,000 which it is hoped the public will supply is excessive, considering the extent and operation of the property. To others, dealing exclusively in stock market matters, regardless of the ultimate liquidated value of the stock based upon physical operations of the mining property, the relative proportions of the stock issue retained by the promoters to that offered the investing public, clearly indicates the trend of affairs.

It is claimed by the promoters of the new Chuquicamata company that there has been developed to date, approximately 100,000,000 tons of copper ore having an average content per ton of 1.75 to 2.0 per ton copper. Although a considerable area of mineralized ground was partially developed by means of the earlier mine-workings, which have been a source of information to the engineers in charge of the development work, the aggregate ore exposures therein would represent but a fractional part of the total prospecting necessary to develop the tonnage of ore claimed by the promoters, inasmuch as the older workings were mainly superficial. Eliminating that factor in the development it will be interest to note that six Star traction-drills now have been in operation on the property for about a year churn-drilling the orebody. During the year's operations the drills have been actually operated only about fifty per cent of the time, due to climatic conditions and difficulty in drilling resulting from the peculiar structural relation of the rocks due to the extensive faulting. In view of these circumstances the declared development of 100,000,000 tons of ore in six months is questionable, as also is the claimed general average grade of the ore.

By the leaching process which it is understood the management intends to use in the tréatment of the Chuquicamata ores, it is claimed that a 90 per cent extarction of the copper content will be effected, but no statement of cost per pound of refined metal is given.

Regardless of whether a profit is made on the Chuquicamata operations or not, the Guggenheims will be fully recompensed, financially, for their efforts in promoting the new company. This will be accomplished in part, through the plan of financing the property as hereinbefore outlined, and later through arrangements that will tie up the Chuquicamata company in a smelting, refining, and selling contract Ample evidence along that line is available from the history of the Utah Copper, Chino Copper, Ray Consolidated, and more recently, (as outlined elsewhere in this issue by Mr. Sidney Norman, representing the minority stockholders) of the Federal Mining & Smelting Company, all of which have been tied up on long term smelting contracts affording the Guggenheim interests outrageous profits as compared with what might have been obtained in a competitive market.

Of course, in order to acquire these contracts it has been necessary at times for the Guggenheims to consider investments in the respective companies securities, but, relatively speaking, the term of contract together with the excessive charges imposed on the individual company under the agreement, permitted an ultimate capital return to the Guggenheims far in excess of the initial investment in company securities, which latter oftentimes were sold in the open market at a favorable profit, and in no instance at a loss. Therefore, it will be noted that investments in the securtities of other companies by the Guggenheims is merely a means to an end. Having secured a long-term refining and selling contract, an investment on their part directly in the mining or milling enterprise is unnecessary, for the very apparent reason that through holding that agreement, indirectly they control the proposition.

Aside from the other circumstances surrounding the control of the Chuquicamata project as hereinbefore noted, the probability is that the new plant will not produce refined electrolytic copper but rather a precipitate which will require refining at one of the Guggenheim smelteries—under a contract which will afford practically the entire profit of operations to them. When such an agreement is consummated (provided there shall be any product to treat) the Guggenheims then can withdraw from the company by gradually disposing of their share of the remaining $95,000,000 capital stock to the public, and still continue in control of the property, as theretofore, through the medium of the smelting and selling contract. Even though the property should succeed in maintaining operating expenses only, insofar as the mining and milling operations are concerned, the increment derived on the smelting, refining, and marketing of the product would amount to many millions of dollars during the life of the property.

Thus, assuming the ore tonnage developed (100,000,000), average copper conten (2.0% maximum), percentage recovery, (90%) and other managerial statements to be correct, then, if we should assume the treatment of 7,000 tons of ore daily as the capacity of the mill, and an allowance of ten per cent loss in smelting and refining, the life of the property would be forty years. During that period, on a copper metal production totaling 3,240,000,000 pounds, and allowing a minimum profit to the Guggenheims under their usual "contract" of 1.75 cents per pound of refined, market-

ed metal, their profit would represent $56,700,000, or at the rate of $1,417,500 annually. This amount, added to the sale of 50 per cent of the $95,000,000 of stock in the company that remains after bond conversion provisions, would afford a yield of $47,500,000, making a grand total rake-off of $104,200,000 for the Guggenheims, without a dollar's expenditure or one cent of risk on their part.

AN HONEST ANNUAL REPORT

The annual report of the Phelps-Dodge company for the year ended December 31st, 1912, made its appearance on the first of the present month. It is a model of concise, truthful information and as such we commend it to the mining and ore reduction companies which apparently strive as hard to deceive shareholders as this company does to let the world know just what it is doing. A careful perusal of the several balance sheets clearly illustrate the practice of the management in the presentation of facts. Each report is complete and in detail, so that the distribution of accounts is not difficult to follow. Of particular interest is the manner in which the management cares for the amortization of its several properties. Renewal funds are carried as they should be, and the annual depreciation on plants and mining properties is lucidly presented. The valuation placed upon the mining and reduction properties is evidently conservative, and at no point is there to be found any deviation from a conservative and straightforward policy of publicity.

The company owns important mercantile establishments at its various mining, milling, and smelting points. In these, primarily, the object sought is to afford employees an opportunity to purchase merchandise at a small profit over actual cost. This feature is best illustrated from the fact that, during the year 1912 the gross sales amounted to $6,321,410.86, on which a profit of but 9.12 per cent was earned.

During the year the quantity of copper delivered was 192 297,374 pounds, of which 98,267,037 pounds were sold to domestic, and 94,030,337 pounds to foreign trade. The average price realized on sales for the year was 15.51 cents a pound, net cash, f. o. b. New York.

On the basis of its issued capital of $45,000,000, dividends amounting to $6,750 000 were paid during the year, or at the rate of fifteen per cent for the year. This was occasioned by the payment of two extra dividends (one of 2 per cent at the end of June, and another of 3 per cent at the end of December) in addition to the usual quarterly dividend of 2.5 per cent. The financial statement also indicates a substantial reserve fund against stocks owned, as also a satisfactory surplus account.

The subsidiary companies of the Phelps-Dodge interests are: The Copper Queen Consolidated Mining Company, Detroit Mining Company of Arizona, Moctezuma Copper Company, Burro Mountain Copper Company, Stag Canon Fuel Company, and the Phelps, Dodge Mercantile Company.

During the year the total copper ore extracted from the company mines amounted to 1,983,244 tons of which quantity 1,098 528 tons were concentrated, and 794,716 tons smelted directly. The total amount of copper bearing material smelted, including ores, concentrates, old slag, and cement copper, amounted to 1,051,315 tons. In addition to the above there was produced, and sold, 11,626 tons of lead ore from the Copper Queen mines, yielding 30.434 pounds of copper, 2,953,685 pounds lead, 326,962 ounces silver, and 3,889 ounces gold. Of the total ores and concentrates smelted 953,741 tons were derived from the company properties and 97,574 tons were purchased.

The Copper Queen smelting department report, covering the operation of that department, states that there was treated on the entire plant, 1,151,949 tons of charge, of which 884,814 tons were smelting ore, 73,720 tons were silicious ore for the converters, and 193,415 tons composed of converter and furnace secondaries. The bullion produced was 124-915,708 pounds.

It is stated that a great reduction in the amount of flue dust was effected when the fumes from the converter were deflected from the cupola dust chambers, and a still greater reduction when the reverberatory plant started up, and the fines sent to that department. It dropped from a maximum of 8.87 per cent per ton of charge in the month of June to 2.72 per cent per ton of charge in the month of December.

In April, 1912, a change was made from the old acid process to the new basic process of converting matte. Two stands of the Great Falls type of basic lined converters were placed in commission toward the end of the year, and the remainder of the old-style barrel-shaped converters will be replaced by Great Falls type converters as soon as practicable.

The report of the Detroit Copper concentrator operations is outlined in the following table:

	Assaying % Copper
Ore concentrated, 501,928 tons...	3.08
Concentrates produced, 70,428 tons	16.69
Savings:	
Ore and concentrate...........	76.12
Ore and tailing...............	77.34
Concentrate and tailing........	77.06
Assays only	77.43
Tailing assay	0.811

Tons ore milled per ton concentrate	7.1 to 1.
Actual percentage running time to total time	95.11
Tons ore milled per 24 hours actual running time..............	1441.8
Gallons water used per ton ore milled	511.2

The detailed report given above is noteworthy for its brevity and correctness. For example, the methods employed in the calculation of the general average percentage recovery of copper mineral from the material is important. Note that the per cent variation between the highest stated average percentage recovery (77.43%) and the actual operating results (76.12%) affords a difference of less than 1.5 per cent. This method of determining the percentage recovery is commendable, and should be more generally employed by other large mills; in fact, it is the only correct means of determining absolute results, and precludes the padding of operating reports. Other equally important factors are the presentation of the facts governing the actual period of operation through the year, and the average daily tonnage for the year.

The Detroit smeltery blast furnace and converter operations show the treatment of 173,266.8 tons of material from which there was produced 24,802,789 pounds of copper bullion. The general average percentage recovery in smelting and converting for the year is stated as 93.863 per cent.

The mining fraternity generally will be glad to know that Prof. Chas. E. van Barneveld, has accepted appointment as chief of the department of mines and metallurgy of the Panama-Pacific International Exposition and that he will be at his desk, Exposition headquarters in San Francisco, on May 1. For the past fourteen years the professor has been at the head of the mining department of the Minnesota School of Mines. Previous to that he spent six years in general mining practice in Colorado, the Southwest, Mexico and Canada. The professor is a graduate of McGill University, Montreal, Canada, and enjoys a wide circle of friends in the mining and metallurgical world.

Copper production of Peru in 1912 was 27,400 long tons, as against 26,000 in 1911.

PASSING OF TWO NOTABLE CHARACTERS

Developments of Past Month Bring to Mind Recollections of Methods Employed to Create Booms and Manufacture Mining Engineers and Magnates.

During the closing hours of the stormy month of March, and within four days thereafter, the passing of two notable characters was announced. The first, Joseph T Jenkins, for many years mining editor of the Salt Lake Tribune and the Intermountain-Republican, passed to the Great Beyond Mr Jenkins possessed signal ability as a newspaper writer, and had many traits of character which, had they been differently directed, would have made him an enviable name. But let us draw the mantle of charity over evidences of his short omings, and join with those who knew him, in saying: Poor "Joe," peace to his ashes.

On the evening and night of the fourth day of April, following the event recorded above, the young "multi-millionaire" mining magnate, Daniel C Jackling, whose portrait is presented at the head of this column, was guest of honor at a banquet given at the Alta Club for the purpose of celebrating the unparalleled success of his numerous exploitations, and to say "good-bye, Jack," on his retirement from this field of his former activities.

Before proceeding with further discussion of the operations of this brilliant young millionaire in this and neighboring fields let us revert to the earlier history of specu'ative manipulation which resulted from the impluse given by the facile pen of the 'ate Mining Editor Jenkins; because it was to his persistent energies along the chosen line that the eminent engineering skill, and managerial ability, attributed to Mr. Jackling, as well as the success of the various enterprises with which his name was connected, was due almost wholly to the efforts of Mr. Jenkins And yet withal, we are advised that he was permitted to die in comparative poverty. In order to show how the speculative appetite of communities involving vast financial interests was worked up—in which Mr. Jenkins played a leading role—we can do no better than reproduce the following article from the Bingham Bulletin of Friday, February 24th, 1905:

There was a time, and not very long ago when the mining columns of the Salt Lake Tribune were confidently and eagerly searched each morning for the latest and most reliable information upon all matters pertaining to the new life upon which the mining industry had then just entered The accidental discovery by the Wilman brothers, of a large body of lead ores upon the old and long-abandoned "Tenderfoot" claim, near Park City, had led to the development of the enormous bodies of rich silver-lead ores or the Mayflower and Silver King "Old Camp Floyd," after a slumber of more than twenty years since the closing of Sparrow-Hawk mine and mill by Captain Shaw and the English owners, had suddenly been aroused to new life by the discovery of gold in paying quantities in the carboniferous shales that extend over vast areas of that district, and which for a time promised to rival in extent and richness the "Rand" of South Africa, with which it was compared in many material characteristics; likewise the old camp of Ophir, whose low grade ores had slept for even a longer period of time, was, by the application of modern skill and improved methods, in the midst of a season of unprecedented prosperity At Tintic the "Grand Central" and the "Uncle Sam" had suddenly burst into prominence by reason of discoveries of large bodies of high grade ores, in hitherto undeveloped portions of that erstwhile quiet camp. Even the lease-worn camp of Bingham had experienced a new birth, due to the accidental discovery of vast bodies of copper sulphides in the Highland Boy mine, following the usual disappointments which result from efforts to extract gold from rocks wherein none is contained

The slump in the silver market and incidental paralysis of dependent industries due, in large measure, to the hostile attitude of the last Cleveland administration, had driven the restless miners to search anew abandoned "stopes" which marked the former hiding place of valuable ore bodies, and to pursue to greater depth the faded evidences of pre-existing wealth, with the result that every old "camp" could now boast of one or more old mines rejuvenated and many new and promising discoveries made in hitherto undeveloped grounds. The precious metal contents in many instances was found to be in diminished proportion, and base and refractory substances had intruded instead, but improvement in metallurgical knowledge and mechanical skill had kept pace with emergency Meanwhile the people had acquired habits of economy and thrift and many had laid by hordes of comfortable proportions, and were eagerly looking forward to some favorable opportunity of investment which promised quick and profitable returns.

A great "mining boom" was on in earnest and the air was laden with reports of reputed great strikes Dreams of sudden wealth haunted every household. A mining and stock exchange became the necessity of the hour, that the widow's mite the banker's horde, and the gambler's "wad" might have ready opportunity to invest in the representatives of the new born wealth. Then it was that the Genius who presided over the mining news of the daily paper became and was a real autocrat. He stood between the investor and the vendor, and by coloring or distorting the facts, had it in his power to make or dissipate the hope and fortune of either with the stroke of his pen. How important was it then that this department of the daily paper should be administered by a capable, conscientious and honest person

The Salt Lake Tribune, having always been the friend and organ of the mining industry, easily maintained the lead as the dispenser of what was believed to be the latest and most reliable news in all that pertained to that field of enterprise

New corporations, holding out glittering promises, sprang into existence with bewildering frequency until the list upon the daily call-board of the Salt Lake Mining and Stock Exchange numbered nearly one hundred. True, but few of the producing mines were included in the list. The real value of their shares was too high for the purse of the small investor, who demanded a large number of shares for a small sum of money. They argued that the producing mine had sprung from a prospect hole and all remembered when the shares of the Silver King were almost as cheap as the meanest on the list Then why not all those become great mines also? And this thought received daily encouragement not only from the promoters of various wildcat schemes, but from the daily press, and especially the Salt Lake Tribune, whose mining columns teemed with fabulous stories of "strikes" upon claims which had never felt the impress of the miner's pick, and of promised early dividends from others upon which not a pound of marketable ore was ever known to exist. And thus was the public appetite whetted from day to day, speculation was at fever heat, transactions upon the stock exchange reaching scores of thousands was of daily occurrence. Meanwhile the real mines continued to pour the result of their riches into the public lap, which made it all the more easy to maintain the delusive speculative interest in the "wildcats." And this condition continued with little abatement of interest for some three years, during which time probably two millions of dollars were drawn from the meagre earnings of clerks, servants, teachers, laborers, and small merchants, and dumped into the stock market in exchange for shares that never possessed intrinsic merit equal to the value of the pulp of which the paper was composed. And all this made possible chiefly through abuse of the power and prestige of the Salt Lake Tribune by the trusted editor of its mining columns.

Did this editor profit by the waste of other people's money which he caused? "It is said" that he did to the extent of at least $40,000, but, "it is also said," that finding accumulations too slow, he entered the brokerage firm of Higginbotham & Company in order that he might be in position to anticipate advances in the share market which were sure to follow the publication of manufactured falsehoods pretending to disclose inside news of daily "strikes" in the "matchless" Tomcat mines.

But, "it is further said" that the scheme proved unprofitable, in fact, disastrous, for it appears that the active members of the firm had not been let into the secret (whereby "strikes" seemed to be always on tap, just at the proper moment, to enable the firm to make clever turn

before less favored brokers could "catch on,") and therefore they were naturally disposed to regard as serious, everything which appeared in the Tribune. Thus it happened, "it is said," one fateful morning that a "manuscript" recording a phenomenally rich strike in the "Peerless Tomcat," and designed as a "double header" for the mining columns of the Tribune the following morning, nad been left on the desk of the versatile partner in the back room of the office where it was prepared. The Tribune appeared as usual, but contained no news of the "stupendous" strike in the sky levels of the Master Tomcat mine. In fact, there was no mining news whatever that morning. The voluble editor-partner failed to appear at the usual hour. Of course, he must be sick; he was not very strong at best and was subject to sudden attacks which frequently caused his absence for days and sometimes weeks, but he always came back smiling and there was no cause to fear this time. But how fortunate that the public had not caught on to news of the strike, thus reasoned the remaining member of the firm of Higginbotham. Then they went forth and loaded up with the shares of the Tomcat mine until the firm's entire cash balance was exhausted, and then some more; but this was a fatal error. The public never learned of the "strike" and therefore, refused to buy the shares of the famous feline; thereupon the firm failed and "it is said" the strike editor of the Tribune dropped his "wad," whatever that may mean.

In the progress of time the more wealthy class of people became infected with the speculative stock-gambling craze, so that there was demand for higher class securities, and transactions involving large blocks of shares in dividend paying mines were of frequent daily occurrence. But the want was not "long felt." The Uncle Sam mine at Tintic which had produced several hundred thousand dollars worth of valuable ore under the individual ownership of "Uncle Jesse" Knight, was for sale on the "quiet." True, it was not producing at that time, because, as the sequel showed, it had been gutted of every ton of known marketable ore. But this fact was not known, or suspected, by the stock-buying public; besides, "Uncle Jesse" was a peculiarly eccentric man and had often been heard to say, when asked why he did not continue to mine and market the vast bodies of rich ore therein exposed, "that the money was safer in the mine than in the banks, and as he was not in immediate need of money he preferred to keep the mine closed."

Having secured the necessary authority, Hon. Dave Evans opened subscriptions to shares in the "Uncle Sam Mining Company," a corporation to be formed which would take over the Uncle Sam mine. There were to be 500,000 shares, and the subscription price was one dollar per share. Only a selected few were let into the deal at first, and in an incredibly short time it was announced that the shares had been over subscribed many thousands; whereupon the Tribune began an incessant fusillade of falsehoods, picturing in nauseous terms "stupendous ore reserves" which only awaited the magic touch of the new corporations to convert them into immediate dividends. And thus, even before the new shares could be printed, the price had been forced above $2.00 per share, so eager were the investors to secure a small holding in this bewitching venture. Ten thousand shares had been discreetly placed at the disposal of the Tribune staff, of which 6,000 shares were retained by Mr. Lannan, 1,000 was awarded to———, and the remaining 3,000 shares to the editor of the mining department of the paper, J. S. Daveler, foreman of the printing department, was ignored in the division of the spoils, and therefore "gave the snap" away.

The success of this fraud prepared the way for the perpetration of another, even more glaring, along the same lines, and so the "Carisa," another worked out bonanza, was put out with the same number of shares, subscription price, $1.25 per share. This was likewise over subscribed, whereupon the price advanced to $1.60 before the shares were delivered. The Tribune's efforts to secure higher prices having been even more vigorous than in the cause of the Uncle Sam, and it is said the mining editor's allotment consisted of a like number of shares. Then came another companion piece and neighbor, the "Yankee,' the career of which was phenomenal. Within the space of a few weeks its shares had been rushed from about ten cents, which was too high, to over $5.00, the mining editor being credited with a net profit—for his "influence"—of over $10,000. The "Chloride Point," near Mercur, under the chaperonage of "Parson" Tibbals, with the promise of early dividends, persistently urged by the Tribune, found ready sale at $1.30 per share upon a capitalization of 400,000 shares. This proved a dumping ground for the savings of the teachers in the various public schools, and even ministers of the gospel are said to have yielded to the temptation to get rich quick. The intrinsic value of these shares was never a measurable quantity.

By the same methods the Northern Light, adjoining the Chloride Point, with 400,000 shares, had been pushed from nothing, its true value, to $1.50 per share. The "Daisy," worth nothing, to 65 cents at and near which price the whole bunch of 300,000 shares were unloaded upon the public. The list of worthless stuff located at various points throughout the state might be extended indefinitely, but space and time forbids. One special case we have in mind, however, should not be passed over. It is the California mine, near Park City. This property was being developed in a vigorous and systematic manner, and for a time gave promise of real merit; but the owners apparently became tired of the long wait for legitimate results and so determined to reach the goal by a short cut. The services of the Tribune were enlisted and soon a substantial boom in the share market was an accomplished fact. The price of shares rapidly advanced from a few cents to nearly $3.00 per share. Upon a morning following a certain day on which the highest recorded price of sales on the exchange was $1.45, the Tribune announced the purchase at private sale by McCornick of 15,000 shares of California stock at $1.75 per share, or thirty cents a share above the market. Of course, there was not a word of truth in the statement, but it had the desired effect. The market price almost immediately passed the $1.75 point supposed to have been set by McCornick.

At this juncture poor old Ben Sprenger, an ex-member of the Exchange, planked down $1,750 in gold in exchange for 1,000 shares of California stock. The mystery in the transaction was, where did he get the money? for he was known to have been broke for months. The last $2,000 he possessed he had given to his invalid wife for safe keeping lest it be lost in wild speculation as other thousands had before. But there was nothing strange in the matter after all. Having read in the Tribune of the latest strike, and how McCornick was buying the shares without regard to price, it was easy to convince his sick wife that great profit would result from investment of the "sick fund" in California shares, and so it was done.

Mrs. Sprenger died soon after, but not until she had seen the price of California quoted at less than ten cents. Poor soul, she seemed to lose interest in life, and her strength failed rapidly after those precious gold pieces had been carried to the dumping ground. As to the mining editor, he has not been well, either, of late, but occasionally returns to his post long enough to announce some of the more important strikes made in the numerous properties of the United States Mining Company, and to examine the market list so as to be prepared to realize on those 400 shares in case the price should at any time exceed $26.50 per share.

Following the publication of the foregoing article Mr. Jenkins was retired from the service of the Tribune. But soon thereafter, on the establishment of the Intermountain-Republican, he was given full charge of the mining department of that paper.

About this time, Charles M. MacNeill, and others, in whose employ Mr. Jackling was then engaged as foreman of their smelting enterprises in the State of Colorado, secured control of the property which thereafter became known as the Utah Copper Company's mines at Bingham, of which Mr. Jackling was made manager. Up to this time Mr. Jackling had had no technical training, or practical experience in the operation of mines of any character, nor in the treatment of ores by any process, other than that of smelting, (which he gained during his Colorado employment) and of roasting ores preparatory to the application of the leaching process while in the employ of Capt. J. R. De Lamar, under the management of Mr. H. A. Cohen, at Mercur in this state.

The negotiations for the sale of the control of the property to MacNeill and others were conducted by Mr. Cohen under an option held from the then owner, in which negotiations he was materially assisted by Mr. Jackling, who then, as now, because of his genial social qualities, was held in high esteem by Mr. McNeill and associates. For this service Mr. Cohen's commission, amounting to about twenty-five thousand shares of Utah Copper stock, was divided equally with Mr. Jackling in addition to which the former owner, Col. Wall, added in cash $5,000.

Now it appears that Mr. Jenkins, for some reason, was not friendly to Col. Wall, and that some time after the exploitation of the property began under Mr Jackling, relations between Wall and Jackling became somewhat strained, because of Wall's disapproval of Jackling's method of equipping and operating the mine. This, together with Jenkins' well-known propensity to magnify and laud everything done by each incoming new mine captain, afforded ample excuse for the exercise of his accustomed journalistic methods to at once begin the task of making a great mine magnate of Manager Jackling, and at the same time discrediting and disparaging the presumptions of Col. Wall—who was yet the largest individual owner in the property—wherein he had from time to time expressed disagreement with the manager's operating methods. This, of course, was assumed to be pleasing to Mr. Jackling; at least, it resulted in special consideration being awarded at all times to Mr. Jenkins. And so the work of building up a great engineer and a great mine began, and so it continued from day to day, ad nauseum, until the columns of the mining department of the Intermountain-Republican teemed with effusive utterances magnifying every blundering movement and act of the manager in his abortive attempts to develop and equip the mines.

Mr. Jenkins had been frequently heard to remark jocularly that during his newspaper experience in Colorado he had made some sixty odd colonels of men

market. Hayden, Stone & Company, and other brokers, discerning the market value of Manager Jackling's reputation as a great engineer, thus built up, having first secured large holdings in the Utah Copper, joined the Colorado contingent in the flotation of Ray and Chino, Hayden, Stone & Co. becoming official underwriters for all bond and stock issues put out by those companies, the large clientele of that company at once assuring the absorption of any issue bearing their endorsement. And in this manner many millions of dollars have been secured from the general public by which means all the needed finances for any scheme, no matter how spectacular or chimerical, were readily obtained.

Notwithstanding the magnitude—on paper—of these three big enterprises, the ambition and greed of these promoters was not satisfied and so Butte & Superior was hooked up, and the public mulcted of several millions of dollars, no mean portion of which was contributed by local followers, many of whom had been beneficiaries of the profits arising from the gratuitous distribution of Ray and Chino shares, as before stated, and a considerable number of the sufferers from the Butte & Superior deal, it is said, were present at the "farewell banquet" given Manager Jackling early in the present month. The inside history of the Butte & Superior deal has already been given in a former issue of this journal.

Following this, these grasping promoters, with their precious mascotte—who in this case was supplemented by A. F. Holden—proceeded farther north and undertook, under the name of the Alaska Gold Mines Company, the rehabilitation and market promotion of the old and worthless property previously known as the Perserverance, and situated on the mainland of Alaska, about six miles from the famous Alaska-Treadwell gold mines, upon the successful operation of which it was hoped to float the shares of the Alaska Gold Mines Company, solely because of its proximity to this great mine. But the fact becoming exposed that the property of the Alaska Gold Mines contained no ores of any possible commercial value, of course an absolute collapse, so far as distribution of the shares is concerned, followed. True, the "noise" is still being faintly kept up, and considerable work is being done upon a great tunnel, but every prediction of the promoters has been discredited and this unsuccessful attempt to fleece the public forbodes an early and absolute failure of the scheme. The chief trouble in this case exists in the fact that the scheme was born about two years too late, and after the early demise of the master scheme had become a certainty.

o

SMELTER SMOKE COMMENT

In spite of the fact that "big business" does not dare to say a word or to lift a finger against the smelters, no matter how much of a public nuisance they may have been proven to be, there nevertheless are scores of prominent people in the city and the county who have expressed their hearty approval, and have strongly commended Mines and Methods' smoke fight.

A prominent mining engineer and operator writes: "I have read with much interest the articles on smoke in Salt Lake City. I distinctly remember some years ago when the dust from the unmuzzled smelter stacks was reported by prominent professors and officials to be 'volcanic dust,' but I had some of it examined by an assayer, who told me the volcano that emitted that dust was within the valley. * * * Don't use my name in connection with this, publicly. I am in the employ of the Blank Blank Mining Co., and you can see they would not like me to butt in."

A leading citizen of Salt Lake says: "You have made the most significant revelation and the most important discovery ever made effecting the history of any city. Your smoke stories will mark an epoch in the growth of Salt Lake City. It may not come now, but it will come ultimately, and it will be principally because of your tracing the smoker to his home."

The owner of a large non-smoking furnace in this city says: "You have astonished this whole community; that the smelters are largely to blame for our city smoke is a terrible charge to make; terrible because we must have the smelters and their business, and yet it does seem that you are right in the matter. I am indeed sorry to be forced into this belief. However, the city was here first and I hope vigorous and effective action may be taken soon that will bring the least harm to the smelters and the greatest good to the city.

A Salt Lake City manufacturer comments as follows: "That is a pretty serious charge you have made against the smelters, but your bravery in speaking out in this matter is very refreshing. There has never been so plain a case of circumstantial evidence against any one anywhere as you have made against the smoke makers. I am a serious sufferer in both health and property loss from this exasperating smoke nuisance, and I will contribute one hundred dollars toward any campaign that will remove the smelters from the valley. However, I cannot wish them to suffer the loss of a single nickle, and as a property owner in this city I am willing that the city should bond itself as much as three million dollars to pay for the removal and rebuilding of the smelters a safe distance from here."

o

SUMMER "SALT" STORMS

The so called "salt" storms that are common in Salt Lake City in the summer time when thunder showers occurring after a long dry spell wash down the dust from the atmosphere and spatter it over our windows and clothing in a very nasty manner, really contain no more salt than they do pepper; the salt flavor tasted is from the perspiration of the finger or hand of the taster.

The dust is almost exclusively desert dust so far as it is derived from points outside the Salt Lake valley, which the summer winds keep blown about from place to place, though it has just been ascertained from an examination of the gray dirt deposited last summer on the Boston building roof during a thunder shower from the southwest and carefully gathered at that time, that it contained smelter smoke particles in good quantities. As a matter of fact, a competent assayer made a careful fusion test of a quantity of this dust and found sulphur in appreciable quantities, a summary of the analysis revealing the amount to be at least one and one-half per cent of the total bulk of the dust gathered from the copper roofing after the shower.

Since the fires of Salt Lake City were not burning (in August), and since the storm came from the southwest across the Salt Lake valley, we are forced to the conclusion that the sulphur was not from the coal burned in Salt Lake City, nor from the spray (?) from Great Salt Lake, but that it came from the sulphur spouted into our summer sky by the smelters.

The amount, 1½ per cent, is however. but a very small amount of the sulphur combinations indicated to be in the air by this test, because during the storm. the surcharge of the sulphurs in the air. is transformed into sulphuric acid and other solution forms of sulphurs, by the rain drops, and this is not deposited as a dust or powder that can be gathered up as was the sample under consideration. From this observation it will be seen that the haziness of summer, which is washed down in great "gobs" by summer showers, is caused very largely in the Salt Lake valley by a prolific sulphur maker—or to be exact. THREE good, hardworking sulphur makers.

ĸtracting Gold From Gravel Deposits (VI.)

By AL. H. MARTIN.

ılligent prospecting blazes the way ·ofitable mining. Unless the extent ·alue of a gravel deposit is known ıd all conjecture, the success of the prise is shrouded in doubt. As in ɀ mining, it has too often been the ;ce to outline operations and in- costly equipment before a fitting ledege of the property has been red. In other cases inexperienced have supervised the perfunctory ex- ıtion and testing of properties, and ıs that would have been valuable posts to the qualified engineer as blind walls to the untried men in e of the work. There are so many essentials entering into the ex- ıtion of a placer property, that the r is worthy of a greater consider- than has been generally extended ;ot only is the prospecting of the d calculated to determine its merit ›ing operated, but also should indi- the best methods to be utilized in :tion of the gold.

the deposit is best worked by a e, or an elevator, or a steam shovel, ıta so indicating should be gathered e testing of the material. Ground ifficult or shallow to warrant the lation of a bucket-elevator dredge be an ideal project for the drag- xcavator or hydraulic monitor. And er deposit that was too deep for restricted methods, might develop ı profit yielder if mined with es. The machine best adapted for articular work is the one that gives num results at a minimum cost, ut sacrifice of efficiency. Limited d, climatic conditions, local laws regulations affecting operations, :ial status of the operating com- —all these and many more factors ɒd consideration aside from the value and character of the deposit consideration.

CAUSES OF FAILURE.

: vast majority of placer mining es are directly traceable to an im- :t understanding of the conditions lent at the outset. And it can be ' asserted that fully two-thirds of ilures were due to careless prospect- Even when the utmost care is ex- ·d in testing ground, the greatest :tion must be exercised to guard st erroneous samplings. So well s danger comprehended by expert ıg engineers that in examination of California dredgable ground, and computation of average values throughout the deposit from the samples secured, it is customary to figure the gold content recoverable at 75 to 80 per cent less than the value indicated by samples from drill holes and prospect pits. There are so many chances for errors in collecting samples, and in their subsequent handling, that the reduction of indicated values about one-fourth is considered the one safe course. And actual operations have demonstrated the practice to be justified as there is always a certain amount of fine gold lost in handling the gravel, in addition to the varying values between indicated asd recoverable gold content.

While their cost oftentimes militates against their employment, prospect shafts are unquestionably the safest and most certain guides to the actual merit of a placer. This is particularly so when the work is in the hands of men who have not had long experience in sampling gravel. Presence of quicksand or very loose ground, requiring extensive timbering, often precludes the sinking of these shafts because of prohibitive cost, but under fairly favorable conditions their use is strongly recommended by most engineers. The shaft enables the examiner to gain a more comprehensive knowledge of the character of the ground and formation, facilitates the taking of a large sample, and largely reduces the possibility of errors in computing value of the estate if care is exercised in collecting the material.

It is the usual practice to sink round shafts with a uniform diameter of thirty-six to forty inches from top to bottom. If the deposit is deep, ranging below thirty feet the larger diameter is employed, but for comparatively shallow deposits the shaft with a three-foot diameter is usually found of ample size. With conditions favorable such shafts are sent down at a cost of 50 cents to $2 per foot, the expense varying with character of ground, labor costs size of hole, etc. While a fairly large shaft costs more than a smaller one, its use is recommended in testing fairly deep deposits, as it is false economy to cramp the workers, or handicap the engineer in his selection of samples. When the ground is wet and requires extensive timbering, the prospect shaft often ceases to be advisable, as the water not only runs up the cost and handicaps work, but so disseminates the gold values that it is generally necessary to check results with a nearby drill hole. Some operators use iron caissons when prospecting wet ground. In dry ground it is the usual practice to take only a small section of the shaft from top to bottom for testing, but in wet ground, or when the caissons are used the entire content of the pit is taken.

The location of shafts and distance from each other largely depends on the character of the ground. Hence a careful preliminary study of the deposit often results in marked saving of time and reduction of drilling costs. In making the early examination, the engineer usually sinks a few holes at widely divergent points to establish extent of commercial ground, and to learn if the gold occurs in channels or is fairly evenly distributed. If values are found fairly well disseminated and uniform, less testing is required, but if the gold occurs in bunches, or in narrow channels, careful work is necessary to conclusively demonstrate the actual merit of the deposit. After the first shafts have been completed, the engineer generally has sufficient data to outline the character of the subsequent work. The ground is then divided into sections and each division tested.

CORE DRILL PROSPECTING.

The correspondingly lower costs of prospecting with core drills under any and all conditions, and the rapidity with which work is preformed, has made this form of prospecting particularly popular with placer operators throughout the world. The drill works alike in wet or dry ground, and often under conditions where the shaft method would be beyond the range of economic consideration. Consequently the drill has largely displaced the prospect shaft in many districts, notwithstanding the admitted superiority of the latter means in many instances. A careless runner may render sampling of a deposit worthless and misleading by negligent driving of the casing. If the pipe is kept too far ahead of the drill bit the subsequent pumpings often fails to produce sufficient material to give a true index to the gold content of the deposit, while if the drill precedes the pipe an excessive quantity of material is drawn out by the pump. In either instance the samples are worthless inasmuch as they relate to actual value of the gravel. Such errors in drill running have been numerous when inexperienced or careless runners were in charge of machines, and it is largely because of such chances for error that many engineers prefer the prospect shaft. Another fruitful cause of inaccu-

rate samples is the tendency of some drillers to eliminate the casing when prospecting hard ground. The practice is considered as almost certain to give misleading results and is strongly condemned by most engineers, as there is always the danger of loose material below the driving shoe adding its gold content to the actual core drawn out by the pump. This naturally results in indication of a gold content far above that actually existing.

It is imperative that each foot of the casing pipe be marked, also the drill rope, in order that an accurate record of the changing depths of the hole, and efficiency of the drill be kept. The bit must be kept sharp and in best of condition. as a dull cutting edge may result in flouring of gold if used for any length of time. The type of drilling bit is determined by the character of ground, as a hard bedrock, or boulders require a heavier and wider angled cutting bit than loose gravel. A thin-bladed bit is desirable in drilling gravel as a heavy one would pack the material instead of cutting cleanly, and probably force some of it to the side of the pipe below the cutting shoe.

The type of drill used depends largely on its demonstrated efficiency, and the choice of the operator. In California placer prospecting the favorite machine is the Keystone No. 3, of the traction type. It is self-contained, and equipped with either an 8 or 10-horsepower boiler, or electric motor. Electricity is preferred for motive power whenever it can be cheaply obtained, but with the boiler attachment, wood, coal or oil can be used for generation of steam. The casing pipe is generally cut into 5 to 7-foot sections, with inside diameter of six inches. Practice has shown the best results are obtained with a long quick stroke and the drill is usually adjusted to deliver about 55 strokes per minute, with the stroke about 38 inches long. This prevents settlement and recutting of material between strokes, with a possible loss of fine gold. The casing must be constantly kept perpendicular, otherwise a bent pipe may force abandonment of the hole before the bedrock is attained.

The handling of the drill should never be intrusted to an inexperienced or careless runner when gold-bearing gravel is being prospected, otherwise inaccurate samplings and mechanical troubles are practically certain to develop. After the drill is raised from the hole, the loose material in the casing is drawn out by the sand pump; a vacuum machine composed of a hollow steel cylinder provided with a valve on a piston traveling the entire length of the cylinder. The vacuum produced by the action of the valve and piston sucks out the water, sludge and small rocks, which are held in the pump by the foot valve in the shoe. If the ground does not contain enough water, sufficient is kept in the casing to facilitate both drilling and pumpisg.

WHEN CARE IS IMPERATIVE.

As the gold content of most placer deposits is concentrated near the bedrock, particular care must be exercised in completing the final section of the drill-hole, otherwise the care taken in computing value of the upper ground will be of little value. It is on the pay-streak that the value of the enterprise depends, and on the accurate sampling of this depends in a large measure the success or failure of the project. Occasionally a rich pocket of gold may be tapped, and when this occurs, as indicated by the sharp rise in values, it should be noted apart from the record kept of the balance of the hole in order that real average values be not disturbed by a false calculation of excess gold. The pumpings are discharged into small rockers, and the panning carried on in iron wash tubs.

The amalgamation of the gold is carried on under the temperature that would prevail on the dredge, if identical conditions can be provided. If the gold does not amalgamate the reason should be learned, as many placer installations have been failures because of this feature. It then devolves upon the examining engineer to determine whether the deposit is of sufficient extent, and gold values high enough to justify provision of additional equipment for recovery of the refractory values. And even it should be remembered that the deposit must clearly display its ability to return the original investment to stockholders, plus a satisfactory interest rate.

Unlike a quartz deposit, the surface gravel project cannot be figured to produce beyond its demonstrated extent. There is no possibility of future work increasing productive area or value of the material, the enterprise must stand or fall on the results gathered in the prospecting. It is for this reason that the eventual yield of a surface placer can be figured closely, and its necessarily limited life correctly estimated. The ordinary dredge or hydraulic mining project is largely withdrawn from the usual conditions affecting the mining industry, save in exceptional cases, for its period of productiveness, and ultimate yield are capable of mathematical calculation. With the extent, character and value of the deposit conclusively established and comprehended, the intelligent engineer is in a position to recommend the best type of gold-extracting equipment for the particular requirement.

PURPOSE OF PREVIOUS ARTICLES.

In preceding articles the writer has endeavored to point out the merits and demerits of the various mechanical devices for recovery of gold from gravel channels, and the natural conditions that demand consideration before the particular installation is resolved on. Epitomizing, it can be said that the best machine for any particular purpose is the one that best accomplishes its purpose with a minimum expense and maximum efficiency. The experience of the supervising manager is an important element in the successful conduct of any enterprise, and particularly so when gravel mining is concerned. Careless prospecting of the deposit, or ill-advised selection of equipment not infrequently leads to failure, whereas careful work and and consideration in the beginning would have spelled final success. Any man can make a bonanza pay, but it takes a good man to coax profits from a poor mine. The desire to do does not always imply the ability to accomplish. Most men imagine they could manage a mine, but the tried engineer proceeds only when he is absolutely certain.

An immense amount of gravel mining is carried on without aid of mechanical appliances, but the methods are so simple and well-understood that they can be comprehended without special effort. Ground-sluicing is one of the oldest forms of placer mining extant. Man early learned to bring a stream of water from a friendly creek or rivulet to wash away a bank of gravel, and yield unto his keeping the coveted golden grains. This method is still largely employed whenever it can be utilized effectively, but requires considerable water and highly favorable topographical conditions to achieve best results. Oftentimes however it lends itself admirably to the plans of the small operator, particularly when a good tailings ground is convenient, and there are no unfriendly laws to prevent the worker from sluicing the debris to any point he desires. A good water supply, a few ditches or flumes, and sluices to capture the gold as the material is washed down, constitute the required equipment in most cases.

DRIFT MINING POPULAR.

Drift-mining is largely employed in working deep gravel deposits, and many of the best gravel producers in the world are mined by this method. Work is conducted much as in the mining of quartz. Shafts are sunk and drifts and crosscuts extended, or the work is conducted through adits and attendant workings. Generally it may be said that the ideal way of working a drift gravel mine is by means of adits and drifts and raises.

cess of liabilities (not including convertible bonds which will probably be exchanged for stock), (7) Shares of stock issued (including those shares held for conversion purposes which are worth apparently the equivalent of the stocks or bonds for which they are likely to be exchanged.) * * *

The estimate of ultimate ore to be extracted from the mine is the most difficult one to make and has usually been the sine qua non of most attempts at mine appraisal. In the case of the "porphyry coppers" the minimum of this item is definitely known. * * *

Where ore reserves are large in proportion to rate of production or there seems a considerable speculative value in the property the stock may rightly earn a lower percentage.

If a mine is capable of maintaining its present rate of earnings for 21 years, at the end of which time it be entirely exhausted, its earning should be 10% of its present price (its price should be $\frac{100}{10}$ of its earnings) in order to refund the principal at the end of this time and pay 7% interest on the investment, as will be discussed below. Such an age for this class of mines seems a fair estimate. Of course a mine usually does not maintain its maximum output and average grade of ore to the end. We do not expect that the mines taken up in the accompanying table will cease operating at the expiration of the periods estimated for their respective lives, but it is probable that the value of these mines would be about the same whether they maintain their earning capacity for the period given and then cease entirely, or die a gradual death, as is more likely to be the case. For the purpose of this paper it is simply following accepted practice (which we feel is justifiable) to estimate the life of the better developed copper mines as about twenty-one years, adding to or subtracting from this estimate as the comparative conditions of the properties seems to require.

Each person must judge for himself whether the estimated life of the mine, and in fact the other six fundamental items, are too favorable or too severe for the particular mine in question; whether the mine has its estimated ore tonnage largely developed or simply has a promising prospect of ultimately obtaining that much. In other words he must judge whether the risk of the mine not coming up to the given estimates is greater or less than the chance of its doing better.

On first consideration this method of estimating the life of a mine may seem so crude as to defeat the whole purpose of the article. Suppose the mine to have an effective life of 32 years instead of 21 (approximately 50% larger), what will be the difference in the present value of the stock? Turning to Fig. 2 we see that (allowing a 7% return on the investment) the one running 21 years must yield 10.1% in order to return principal at the end of this time. Each dollar annual revenue therefore has a liquidating value of $\frac{100}{10.1}$ =\$9.90. Where the investment runs for 32 years the Fig. shows the required rate of earnings to be 8.6% of the value of the investment, which is then $\frac{100}{8.6}$ =\$11.62 or 17.4% greater than in the former case. Thus the mine with more than 50% longer life is worth only 17.4% (or about a sixth) more

To take an actual case: Ray Con. is estimated to have a life of 23 years. Its earnings should therefore be 9.7% in order to yield 7% on the investment and amortize the principal at the end of 23 years. Utah Copper has an estimated life of 40 years (77 per cent longer) Fig. 2 shows that 8% is required in this case. For each dollar of annual earnings Ray Con. is worth $\frac{100}{9.7}$ =\$10.30 and Utah Copper $\frac{100}{8}$ =\$12.50, or 21.3% more although its life be 74% more. There is thus an economic limit to developing ore reserves, even for a porphyry mine. Fig. 1 shows that, assuming money worth 7% if Utah Copper were to add another year's supply to its reserves the present value of the profits to be derived therefrom is less than 7% what the profits will be 41 years hence. Whether we estimate the life of a mine at 20 or 25 years makes a difference of only about 10% in the capitalized value of its earnings.

The remaining three items on which calculations are based are obtainable from reports issued by the companies.

The accompanying table gives an illustrative list and works out the intrinsic value of the stock in each case. The figures given are those expected to hold for the whole estimated life of the mine, should present plans and conditions be continued. Increased ore reserves or additional treatment facilities would change the fundamental data so as to necessitate corresponding alterations in the calculations. This will probably soon be the case with such mines as Braden, but at present is only a speculative value. As conditions at the mines are altered the problem becomes altered and the value of the stock should correspondingly fluctuate.

Having assumed the life of the mine, its earnings may be capitalized in several ways. The simplest is to consider all earnings payable in a lump at the expiration of half the mine's life, this being the average time to which payments are deferred. Assuming payments to be made in equal installments over a period of 18 years, for example, the whole may be considered paid at the expiration of 9 years. Fig. 1 shows that, with money worth 7% the present value of such a sum is worth 54½% of its total or 18.545 =9.8 times the annual payment.

H. C. Hoover introduced the practice of capitalizing a mine's earnings by first deducting from each year's earning an amount such that if reinvested at 5% will, at the end of the estimated life of the mine, be equal to the original investment The remaining income is considered a legitimate interest (7% for example) on the value of the property.

$$I = \frac{\left((1+i)^{n-\frac{1}{2}} - 1\right)(E-r)}{\log_e(1+i)}$$

where I= per cent increase desired, i= the amount annually paid as interest per dollar. E-r=per cent reinvested for amortization, n=number of years required for desired increase of capital. Modifying this for our special case where I=100, and i=.04, the equation reduces to:

$$n = \frac{1}{2} + \frac{\log\left(\frac{3.981}{E-R} + 981\right)}{.01703}$$

where n=number of years the mine is to last, E= per cent earnings r=per cent annually paid on investment (herein taken as 7%).

Fig. 2 gives a series of curves showing this under varying conditions. From this

it is seen that to pay 7% on the investment and return the principal in 18 years a yield of 10.9% is required. The value of the investment is therefore $\frac{100}{10.9} = 9.17$ times its annual earnings, which compares with 9.8 as found above by using Fig. 1: this discrepancy representing the difference whether the amortization fund is invested at 7 or at 4%.

The average price of copper is taken as 12½ cents a pound. This has been approximately the price in the past, and there seems no more reason for a lower than a higher price during the next twenty years.

Where the caving system is used, as is the case with Ray Con., Miami and others, it must be remembered that some 15% of the ore will be lost, and the grade of that which is mined will be lowered by admixture of waste. Even where ore is stripped and "steam shoveled" some waste is necessarily mined and a portion of the ore is lost. Thus both the tonnage and grade of the porphyry ore bodies should be modified to represent the ore which will be mined.

The value of stock of subsidiary companies which are independent of the controlling company is given in the column "Cash and Other Assets Independent of Mine."

While the data given in the accompanying table are only approximations, we believe they are as nearly correct as can be estimated from information obtainable. It is probable that time will show these estimates to be nearer the true values of the stocks than is represented by market quotations. If traders in the Stock market were in the habit of giving as much consideration to what they buy as is given to each stock considered above there would be fewer losses sustained, and the market would not have such an undesirable reputation

---

A new alloy, containing a large proportion of iron, has been patented by John F. Duke, of Manchester, England, in United States patent 1,044,761 of 1912. The proportions are: iron, 50.30 per cent; nickel, 19.16; copper, 29.14, and aluminum, 1.40 per cent. It is white, non-corrosive, and resists the action of vegetable acids and the atmosphere well. If more hardness is desired add from 1 to 2 per cent of tin.

Nitrogen amounting to 810,000,000 tons has been wasted in the United States since 1893 through the use of the old-fashioned beehive coking oven. By-product coke ovens would have yielded from this coal 9,315,000 tons of ammonium sulphate, worth \$60 per ton, which could have been used as a fertilizer.

Ultimate Source of the Metals

By BLAMEY STEVENS.*

It is now generally agreed that most metals have been brought to the surface of the earth by volcanic agencies. The question as to how these metals came from the volcanic matrix to the mineral deposit has been often discussed.

It might be useful to give more serious consideration to the ultimate origin of the volcanic material. It is possible that some light might thus be shed on the persistent associations of some metals with certain particular kinds of rocks. For example, the very general association of gold with acid types of igneous rocks, of tin with granites or quartz-felsites, of certain types of deep-seated copper-deposits with magnesian eruptives, and so on.

One interesting question is as to whether the metals brought near the surface by volcanic agencies appear here for the first time, or whether they came from the central core of the earth. The interior of the earth is, without doubt, much more highly metallic than the crust, and so the core is often thought to be the origin of many of the metals which are uncovered by man.

THE DIFFERENTIATION THEORY.

Although a great many theories bearing upon these matters have been discussed,[1] the only one now considered as worthy of much consideration among American geologists is the "Theory of Differentiation of Igneous Magmas."[2] According to this theory, lakes of molten magma are supposed to exist very far down beneath the earth's surface. In these lakes a process of differentiation is supposed to be going on whereby the liquid magma is split up into two or more liquid phases. Each of these phases is supposed to take with it the metallic constituents for which it has the greatest affinity.

This theory is an endeavor, in the most simple way, to account for the emission of a varying and widely-different series of igneous rocks from nearly, if not quite the same vent. The older idea of separate reservoirs was no longer feasible when there appeared to be so many necessary—for instance—seven at Tonopah and nearly twice as many at Goldfield. And thus the idea of the gradual splitting up of one magma was reached.

Like the old simple theory of the sun and stars moving around the earth, the differentiation theory cannot be definitely disproved, but it involves such a reversal of physical conditions, as we know them, from our experience on the earth's surface, that the probability of truth of the theory is reduced to a very small fraction.

The physical conditions which, according to the differentiation theory, are necessary, are that a liquid silicate magma shall split up into two or more liquid silicate magmas. On the surface of the earth we know of no case where this is so. If pressure and temperature could be considered to alter these conditions for silicates in general, it is very unlikely that some extreme type of silicate would not exhibit the same phenomenon on the surface of the earth.

Moreover, the same generalization applies to other than liquid silicates; for example, liquid sulphides, liquid arsenides, and also, where we have had a lot of experience, with solutions in water.

It is true that variations of physical conditions, such as heat, gravity, or electric state, in different parts of a solution may produce corresponding variations in its composition. These effects must, however, be so small as to be negligible in magma reservoirs. If such reservoirs were of large dimensions, convection-currents, due to loss or gain of heat, would entirely nullify any such differentiation effect.

Fractional crystallization is not seriously advanced as a general explanation of the emission of lavas of varying composition from the same vent, and

* Mining Engineer, Temascaltepec, Mexico, Trans. Am. In. of Mining Engineers, March, 1913.

---

[1] Dutton, Hawaiian Volcanoes, Fourth Annual Report, U. S. Geological Survey, pp. 75 to 219 (1882-83).
[2] Iddings, Igneous Rocks, chap. vii. (1909).
[3] Zeitschrift fur praktische Geologie, vol. i., pp. 4 to 11, 125 to 143, 257 to 284 (Jan., Apr., July, 1893).
[4] Philosophical Transactions of the Royal Society of London, vol. clxiii., pp. 147-227 (1873).
[5] Trans. xl., 475 (1910).
[6] The Crystalline Structure of Metals, Philosophical Transactions of the Royal Society of London, A, vol. cxcv., pp. 279 to 301 (1900).
[7] Thomson and Tait, Treatise on Natural Philosophy, p. 423 (1893).
[8] Rankine's Applied Mechanics, 4th edition, p. 303 (1868).
[9] Trans., xl., 475 (1909).
[10] Applied Mechanics, 4th edition, p. 212 (1868); also Philosophical Transactions of the Royal Society of London, vol. cxlvii., pp. 9 to 28 (1857).
[11] Trans., xli., 650 (1910).
[12] Iddings, Igneous Rocks, p. 257 (1909).
[13] Barus, American Journal of Science, 4th Series, vol. ix., No. 51, p. 173 (Mar., 1900).
[14] Bulletin No. 109, U. S. Geological Survey, pp. 27 to 32 (1893). See also A Treatise on Metamorphism, Monograph XLVII., U. S. Geological Survey (1904).
[15] Trans., xli., 650 (1910).
[16] Geikie, Text-Book of Geology, 3d edition, p. 231 (1893).
[17] Idem, p. 244.
[18] Idem, p. 255.

there is no reason for discussing this process at length. To illustrate what is meant by fractional crystallization, we might imagine a garnet to be melted up and then slowly cooled. It would not again crystallize out as a garnet, but as two or more silicates, or as silicates and a residual magma, or glass. As the silicates are formed, the residual magma changes in composition, and with a fractional crystallization theory would be considered to be extruded at periods during such a history. Fractional crystallizations of aqueous liquids carrying silica and other materials have been formed in the end-stages of solidification on comparatively large scales, but these aqueous crystallization phenomena cannot be advanced as any general explanation of the varying composition of successive volcanic outpourings. A proof of the general mixing effect which obtains in magmas, except during the last phases of total solidication, lies in the fact that the large silicate crystals (phenocrysts) which are formed, remain more or less evenly distributed throughout the magma.

Fractional crystallization as a means of segregation has been given as an explanation of certain peripheral deposits of pyrrhotite and nickel-ore. Even this peripheral pyrrhotite-nickel type of deposit, which is described in great detail by Vogt,[3] may now be equally well explained on the more modern and more rational emanation theory; that is to say, they are more likely to be interstitial and replacement depositions made in the solidified periphery by emanations from the still-solidifying central portion of the intrusion.

Some titaniferous iron-ores have been cited as cases of either differentiation or fractional crystallization, and it is quite possible that this may be the case, but titaniferous iron-ore is not a silicate, and proof of its differentiation from silicates would be no proof of the possible differentiation of silicates.

MISCIBILITY OF LIQUIDS.

The tendency of liquids to mix is not due to affinity but rather to cohesion. Liquids possess the quality of cohesion in common with solids, and the property of continuous rearrangement of molecules in common with gases. Any liquid exhibits the property of cohesion among its own constituent molecules. When two liquids are placed together the cohesion may be greater among unlike molecules than among like molecules. In this case the liquids are miscible.

It is well known that in the smelting-furnace a liquid metallic lead-bullion differentiates itself from the liquid silicate slag; in other words, the liquids are immiscible.

No one has ever known, however, of a liquid silicate splitting into two liquid silicate constituents; in other words, liquid silicates are miscible in all proportions.

High temperatures tend towards miscibility; that is to say, away from differentiation. If liquids were apt to contract on differentiation, physical conditions might be so changed at great depth as to render the differentiation of silicates possible. As a matter of fact, when two liquids are mixed there is no known increase of volume large enough to be considered as even a small factor tending towards differentiation.

In 1875 R. Mallet[4] tried to show that igneous fusion is due to horizontal compressive crushing in the earth's crust. He calculated the energy necessary to crush rock into an impalpable powder, and showed that enough heat could thus be generated in the world to account for the fusion of all the lavas and igneous intrusions which are being made.

It was subsequently pointed out, however, that the heat so formed could not be concentrated locally so as to produce a sufficient elevation of temperature for the fusion of rocks.

I have shown[5] that the extension of moderately inclined fissures to considerable depths implies that much superior stresses are required to break rocks at great depths than near the surface. Consequently, a great deal more heat may be developed in the crushing of a deep-seated rock-mass than was formerly contemplated. Moreover, this crushing effect can be repeated over and over again on the same material, producing each time an additional amount of heat. The squeezing of a mass of sand might illustrate this to the average mind. Work is certainly done on the sand and turned into heat, but no particle of sand is necessarily broken or worn. By this crushing effect, under great pressure, the cohesion of a rock-mass is not necessarily reduced. The rocks at great depth are not, in fact, crushed into powder, but forced to flow like plastic material. Pebbles in crushed conglomerates are often considerably flattened, and have even been known to be reduced to the thickness of a leaf.

This form of flowage may be brought about by the yielding of the material beyond the elastic limit, or by the agency of aqueous or other solutions in the pores of the rocks. Such solutions tend to dissolve material from the crystal-faces which happen to be nearly at right angles to the direction of greatest stress, and to deposit it on the faces which are more nearly at right angles to the direction or directions of least stress. In order to estimate the energy transformed to heat, it does not, however, matter how the distortion comes about if we can ascertain the amount of stress and distortion involved.

In order to define our ideas let us represent the mean vertical pressure by DH, where H is the depth at which the distortion is taking place and D the mean density of the overlying rock. Let the greatest horizontal pressure be DHI, where I will be the ratio between the greatest and the least stresses. The stress difference which caused the distortion is then DH–I-1.

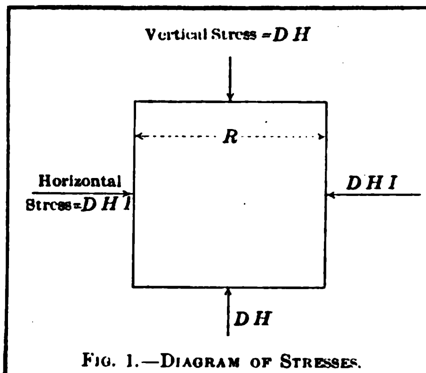


FIG. 1.—DIAGRAM OF STRESSES.

Suppose this pressure difference to compress a unit cube of the rock, Fig. 1, so as to make its least breadth R, instead of unity. As the block must expand inversely as its thickness, the area on which the stress difference now acts is $\frac{1}{R}$.

The increment of energy turned into heat for a decrease —dR of the least dimension will then be $\frac{-DH(I-1)dR}{R}$ so that the total energy of distorting the original unit cube of rock is $-DH(I-1)\log_e R$

If J be the mechanical equivalent of heat, the amount of heat formed per unit weight of rock will be $\frac{-DH(I-1)\log_e R}{J}$ From this formula I have prepared Table I, which is intended to appeal to the judgment of geologists on the general probability of truth of the theory.

Much of the distortion of rocks may be due to metasomasis or the re-formation of crystals, but microscopic examination of nearly all distorted rocks shows that the crystals are permanently strained and therefore the yielding-stress is a criterion.

The phenomena of yield in metals has been studied by Prof. J. A. Ewing and W. Rosenhain,[6] who find that it consists of a number of minute shears which occur mostly along the cleavage or gliding-planes of the crystals.

So far as I know, the effect of other than simple stresses on yielding has never been experimentally studied. This is owing, no doubt, to the difficulty involved in simultaneously measuring stresses in more than one direction on an experimental specimen.

Darwin[7] assumed that the stress difference necessary to yielding was constant, but, as first pointed out by Hodgkinson,[8] this is contrary to the deduction

Mines and Methods

Vol. 4; No. 10 SALT LAKE CITY, UTAH, JUNE, 1913 Every Month

Mines and Methods

Issued Monthly by the MINES AND METHODS PUBLISHING COMPANY, Offices 306 Tribune Building, Salt Lake City, Utah, U. S. A.

SUBSCRIPTION RATES

Single Copies 10c
By the Year $1.00

Applicable to United State Possessions, Cuba and Mexico

CONTENTS: PAGES.

The Wall Street Journal is responsible for the weird story that there is a man in Wall Street, who, for thirty years, has invested or speculated in mining stocks on a system, and has not yet cashed a bet. He bought only the cheapest stocks, paying in no case more than 15c. per share, expecting, of course, that most of them would prove worthless, but hoping that some few might appreciate in value, and make the speculation, as a whole, a winning one. The net result of his operations is that, in the period of thirty years, he has accumulated 1,298,404 shares of 155 different varieties of mining stocks, that the stocks stand him in $125,000, that none of them ever paid a dividend, and that there is now a bid price for only four of the 155 varieties. His holdings of these four he could sell for approximately $250.—Engineering and Mining Journal.

He also could have loaded up on "Comstocks" at many dollars per share years and years ago and witnessed their decline to nothing—with regular assessments added, and still being called for—while, within the past few years he could have secured reams of the highest-priced wall paper in the world and have seen it degenerate into the poorest kind of wrapping paper.

TIPSTERS AND TIPPEES IN THE MINING BUSINESS

One of the most pernicious and insidious practices ever evolved for the furtherance of selfish, dishonest gain and prominence in the business of mining is that of "tipping." The definition of the word and the field of operation it covers is only feebly comprehended by dictionary editors and its baleful influence is so far-reaching that to even imperfectly conceive what it amounts to must necessarily involve years of active life in the atmosphere which it permeates and a clear sense of the object sought in the employment of the art—for it is an art of the most subtle kind.

The tipster in the mining business is not to be confounded at all with the social tipster; nor is the tippee to be confounded with the fawning, servile being who accepts the quarter, half-dollar or other small sum for the closer attention or better service he is expected to (or does) render the tipster—not at all. The tippee in mining is a diverse entity—perchance genderless and maybe characterless—whose influence, once brought under subjection by the tipster, is wielded as a bludgeon or shield (as occasion demands) in destroying opposition to or warding off public criticism and comment upon, schemes being worked to fleece the public. The tipster in mining is usually a broad-visioned fellow and a good judge of human nature; he is jovial, suave and companionable and when his snare enmeshes the tippee whose influence and support he has been working for it feels so comfortable that the ensnared scarcely realizes the discomfort that must follow the inevitable awakening to the fact that he has been "bought" and MUST, thereafter, play the game without protest.

Who are the victims of the mining tipster? Their name is legion. The tippees—as illustrating the classes about which this article is written—are those who are more or less unconsciously made to serve the purpose of the tipster in luring "investors" and "speculators" to their doom. The real victims are the purchasers of the inflated, watered, boosted, boasted and bolstered stocks of corporations, the promoters of which expect to make their REAL MONEY through the distribution of shares and the manipulation of both mines and markets. The investing and speculative public has been educated to believe that most of the crooked business in mining exists only among promoters of what are popularly termed "wild-cat" propositions and this confiding belief is what has made it so much easier for the "wolves in sheep clothing" in the "legitimate" field of mining to command a prestige and following which they do not deserve.

The common "wild-cat" promoter secures the majority of his victims through depicting in glowing terms the successes of others. His methods are largely tinsel and show—blase and crude. He captures the ignorant and unthinking classes—those who readily are made to believe that gold grows on trees—that it is easy to get returns of $1000 for $1. The "wild-cat" promoter also works the tipping system as best he can, but he never becomes a graduate of the scientific class that makes it yield millions—that reduces the business to an art—and he never reaches the class that worship at the shrines of the real masters of the game. It is only during wild boom periods that the "wild-catter" gets past the "penny ante" stage of mining the public and the real, legitimate investors and stock speculators would not listen to him for a minute; they prefer to be soaked right and soaked hard—through their best friends, perchance—so that they will have something to remember; even though they are never able to quite understand why and how they came to be bumped.

In "high finance" mining the tipster employs the most subtle methods. He first of all reaches out and cultivates the friendship and good will of the newspapers, particularly those published in the region of his company's contemplated operations. Does he buy advertising space in the paper? Does he attempt to buy the editors and thus dictate the policy of the publication toward his "enterprise?" Be certain that

he dces nothing of the kind. He knows, to begin with, that the paper at least poses as a friend and booster of the community in which it exists; that he must not attempt to control its poiicy as far as it relates to treating kindly any new and "tremendously important" enterprise that is being launched, and so, after the first announcements are made in big type and the paper has painted the finest picture it can, the tipster usually affects a shyness for publicity; he prefers to let the undertaking "speak for itself," etc., so that when information is released the reporter and the paper's management may properly appreciate his condescension in submitting to interview.

As the "enterprise" is rounded into form and the time approaches for properly impressing the public with the magnitude and worth of the proposition from an investment standpoint, the tipster begins to play his hand. He eventually tells the reporter how much he appreciates the way he treated the information he had released from time to time, and probably says something like this:

"Now, to show my appreciation of the way you have treated me—and assuring you that this invloves no future obligation on your part—I am setting aside a small block of the stock in this company to be sold to you at the present price whenever you see fit to exercise this option. The stock is worth a great deal more than it is now selling for and I sincerely hope and believe that within six months (or any time agreed upon) you will be able to reap a handsome profit. You see I am not giving you anything; I am simply carrying this stock at the price I buy it for today so that you may reimburse me when the right time comes and make whatever profit there may be in the transaction. To give you the stock might be construed as bribery and I am not in the bribing business; it is not necessary to the success of our enterprise that we do anything that is not absolutely legitimate in business; but you know that already. I feel obligated to you for the way you have treated me in the past and this little turn, which costs me nothing, is intended simply as a slight recognition of my appreciation. Please say nothing more about it."

From the minute that reporter left the office of the tipster he became the willing, or unwilling (possibly) slave of that tipster, did he not? While the tipster gave him to understand in no uncertain manner that no obligation attached to that transaction, both were conscious of the fact that a relationship had been established that would allow, on the one side, supplying of any kind of "boost" information to that reporter's paper in the future with a certainty that it would be used—and on the other, no chance to escape. The reporter knew he was "landed," so the only thing to do was to boost as hard as he could and make as much as possible out of his stock option. That reporter had not been bought, in the accepted definition of the word, but he was a tippee, just the same, and placed, so far as that particular proposition was concerned, "hors de combat."

But the work of this tipster has only just begun. This is no ordinary undertaking. It involves the expendieure of millions of other people's money in rounding it out and, before the stock can be unloaded at soaring prices, bonds must be sold. The papers must help—and they do help. Maybe the proprietors are directly—or through the tipped reporter—advised that these bonds are to be made convertible into company stock at a certain price after a certain time. As little of the stock has yet found its way into the hands of the public it costs nothing to move the price up. The newspaper owner or publisher understands this and he buys a block of the stock on margin. As soon as the conversion mark is reached he sells out, make HIS profit, and also becomes a tippee. His paper, then, is a bought booster for the game and it has no chance to escape and indulge in any crticism of Mr. Tipster's "world-beating" (and the word beating is used advisedly) enterprise.

With the foregoing illustrations ot how the mining promotion game is played, in both high and low degree, is not the reader able to comprehend, or understand, at least some of the reasons of why a number of noteworthy propositions have been apparently successful during the past few years?

Does this recital not bring to view a glimpse of the schemes that have been perpetrated in many of the big copper and other flotations which have been monopolizing public attention so long? And does it not suggest that most of the public utterances concerning them need careful weighing before credence is allowed?

Going back over the history of Utah Copper, Ray Consolidated, Chino Copper, Braden, Yukon Gold, Butte & Superior, Alaska Gold Mines, etc., it should not be hard for those who have been following the course of events to appreciate why the daily press has been made subservient to the wishes and the demands of the promoters, and why it has been simply impossible to get disinterested and truthful information concerning the REAL MERITS AND WORTH of any of them. If the newspapers of the country which specialize in mining information have become corrupted and their utterances are no longer to be trusted, what must be expected from sheets controlled by brokerage houses, the modern mining "MARKET LETTERS," etc.? If the tipster is able to control the public press along lines indicated by this review of conditions, why should a prospective investor, or a speculator, expect anything but loss if he relies for tips on market letter information.

SEEKING PASTURES NEW

When a fisherman finds that a stream has been "whipped" too hard and that the fish are shy and scarce, he breaks camp and goes somewhere else; when the stockman finds his herds have cleaned up one range he moves on to another—he seeks new pastures. By the same tokens it stands to reason that when mining promoters find "thin picking" in an overdone section of the financial, speculative and investment world they, too, will seek a less-worn field in which to operate. These and kindred reasons are presented by those learned in the art of successful prognostication as accounting for the reported determination of the promoters of the Alaska Gold Mines scheme to establish headquarters in San Francisco of the "vice-president, in charge of operations."

According to a recent arrival from San Francisco the tip has already been passed to the "inner financial circle" of the coast metropolis that the low-grade porphyry, gold and zinc crowd is going to show the natives how little they know—or ever have known—about the gold mining game. The coast financiers and the coast investors and gold miners are going to be given free kindergarten instruction in the art of mining, milling and smelting Alaska gold ores for seventy-five cents a ton or less. As a result of this education it is promised (so our San Francisco informant claims) that the coast investors will fall over each other in their frantic efforts to play the game. As the west-coasters have never taken to the low-grade porphyry copper mining business on account of their preference for gold mining, it is figured that they know nothing of the deceptive methods that have been practiced in the eastern and foreign markets to fleece the public.

But our San Francisco friend assures us at the same time, that those who are accredited with the preparation of this

move on San Francisco, are destined to brush up against the "real thing" when they undertake an invasion of the jealously guarded preserves of the coast money kings; that they will encounter a combination of princely entertainers who will "go them one better" in any move they make and see to it, at the same time, that their own money stays at home; while any contributions that the invaders feel disposed to make will be as graciously received as was F. Augustus Heinze's "wad" when he undertook to show the easterners how to do a banking business.

From this point the play of the "invaders" will be watched with keen interest, and particularly by those who, through their "investment" losses, have been unwilling contributors to the invasion "jack-pot."

FIGHTING THE SMELTER TRUST

Apparently Sidney Norman who, as a minority stockholder in the Federal Mining and Smelting Company, is conducting the suit for the abrogation of the robbing smelting contract with the American Smelting & Refining Company, seems determined to carry the fight as far into the ranks of the enemy as possible. His latest move was to send a letter to the president of the United States through Senator Poindexter in which he called attention to the activities of the Smelter Trust in the matter of revision of the tariff on lead. About the first of the month the dispatches told of the letter having been submitted, but only a slight inkling of the contents of the document was given by the papers. Knowing that western mining interests would be deeply interested in the subject a copy of Mr. Norman's letter was sent for. It reads as follows:

"I have read with great interest your protest against the insidious efforts of the lobbies maintained by special interests at Washington to further their efforts to confuse the public mind in the matter of tariff revision and take your announcement as an invitation for all citizens to strengthen your hands by giving publicity to specific instances of such tactics.

"I am a plaintiff, with other minority stockholders of Federal Mining & Smelting Co., in a suit which has been brought in the Supreme Court of New York against the American Smelting & Refining Co. and the Guggenheim interests, in which we allege fraud in the execution of a certain contract between the American Smelting & Refining Co. and the Federal Mining & Smelting Co., both of which corporations are controlled by the Guggenheims. In the preparation of this suit I have had occasion to investigate the metal schedule in its bearing upon lead and have also received some interesting information concerning the methods used by the Guggenheims and their so-called "smelting trust" to distort the real position of affairs in the hope that Congress could be induced to retain the present level of protection upon lead in ores and in bullion.

"Early last year the secretary of the Federal company was instructed to send a circular letter to each stockholder calling attention to the probability of revision of the metal schedule under Democratic administration, predicting dire disaster to their investment (already nearly wiped out by the dishonest methods of the trust) and asking each stockholder to use every possible pressure upon the congressional delegation from his particular district to secure retention of the present protective tariff on lead.

"About the same time holders of preferred stock—a 7% cumulative issue of $12,000,000 in $100 shares -were notified that their dividend rate would be reduced to 6%, in spite of the fact that the company's treasury contained ample surplus for full dividend purposes and that the current earnings were more than sufficient to provide the difference. Stockholders who protested against this reduction were informed by a prominent official that the decrease was but temporary and was in the nature of a manufactured argument in favor of retention of the present lead tariff to be used before the Ways and Means committee of the House of Representatives.

"The principal arguments against the reduction were presented by the Coeur d'Alene Mine Owners' Association and a similar organization of Utah. The tariff activities of both of these organizations have been directed and controlled, either directly or indirectly, by the Guggenheims and their smelting corporations. Representatives of these organizations appeared before the Ways and Means committee in fact, though not in name, as the lobbyists of the smelting trust, stating orally and in briefs that the mines of the Coeur d'Alene district received for their product during the years 1909-10-11 the full New York market price of an average of $4.401 per hundred pounds of lead, when, as a matter of fact, they received but $3.84 per hundred pounds. These lobbyists also threatened a decrease in miners' wages or total cessation of work in event of a material reduction of the lead schedule. Through its control of the Federal Mining & Smelting Co., from which it exacts an illegal tax of from $600,000 to $1,000,000 a year through a fraudulent contract that runs for twenty-one years, the trust controls practically 50% of the entire output of the Coeur d'Alene district. Other smelting contracts covering mines which they do not control give the Guggenheims monopoly of practically 75% of all the lead derived from the district. In Utah similar conditions exist, although I am not at this time able to quote exact figures.

"Analysis of the briefs now on file and perusal of smelting contracts then in effect with the trust will prove that my assertions are correct and that the trust during the three years covered by the briefs absorbed in initial charges no less than 37% of the total protective tariff paid by the nation for encouragement of the actual producer. Investigation of local conditions will also conclusively prove that the balance of such protective tariff was more than completely absorbed by a wholesale manipulation of shipments which exacted long-haul rates from the producer and delivered his product at a short-haul point.

"Prominent among those who have represented the trust at Washington during the present agitation is Harry L. Day of Wallace, Idaho, president and general manager of the Federal Mining & S. Co. by virtue of control of that corporation by the trust, who draws a salary of $15,000 a year from the pockets of stockholders ostensibly to protect their interests, but in reality to further the machinations of his real employers, the Guggenheims. Mr. Day is also part owner of the Hercules mine in the same district which now ships its product to the trust under a more favorable contract than is granted to other producers.

"I bring these facts to your attention in the hope that knowledge of them will aid you to fortify yourself against the efforts of the smelting trust, which has until last March, maintained its own personal lobby in the Senate chamber in the person of Mr. Simon Guggenheim and which now seeks to bulldoze and mislead you through its agents. Any expert upon the condition of the lead industry will be able to prove to you that the world's production is now short of consumption, that this country has probably reached its productive zenith and that, within a very few years, the United States must become a buyer instead of a seller in the world's markets. Such an expert could also give you some interesting data as to the reason for the present low quotation on lead, which has fallen nearly 75c. per hundred pounds since last November in the face of a normal business demand.

"My position as the owner of stock in a lead-producing corporation and a supporter of your tariff plans may be considered anomalous by many others similarly situated, but it is evident to me that the tariff question will never be settled for the best interests of all the people until immediate personal profit is in measure forgotten. Personally I am of the opinion that it is both absurd and iniquitous to further fatten the smelting trust of the Guggenheim brothers by taxation of the nation at large. I almost believe that in the long run the nation would experience less loss by closing every lead mine in the country for a period of years, if by so doing it could be rid of a ruthless, blood-sucking organization, without honesty or knowledge of square-dealing, which now constitutes a tremendous menace to the whole mining industry and particularly to the small producer."

STIRS UP NEW YORK EXCHANGE

Following is a copy of a letter addressed by Sidney Norman to the President and Board of Governors of the New York Stock Exchange, on the 17th of the present month:

I acknowledge receipt of your communication of the 13th inst. in which you violate all the rules of justice and fair play in denying me copy of alleged "satisfactory evidence" upon which you base the opinion that the American Smelters Securities Co. did not control Federal Mining & Smelting Co. when the former was listed on your exchange in October, 1909.

Such opinion naturally means that you have elected to ignore the stock books and other records of the company and in their place accept the unsworn, unsupported word of the very official accused of the original deception. It also implies your belief that the affidavit filed by me cannot be substantiated. My reply to you is that every allegation therein will be fully proven at the proper time before an impartial tribunal, thus also establishing the fact that the New York Stock Exchange will go to any lengths to protect those who are financially powerful and that it cares nothing for the public losses made partially possible and in some cases criminally easy by the lax methods of its own committees.

There is another feature of this matter which you have possibly overlooked. If Mr. Brush's secret statements are to be given credence it naturally also means that the public advertisement of M. Guggenheim's sons in in the New York Times of Dec. 21, 1911, was a deliberate lie specifically published for the purpose of misleading the public by further concealing control of Federal. Consequently, if I am well advised, either these statements or the advertisement constitutes a misdemeanor under the New York criminal statutes.

The matter will by no means be allowed to rest where it is and you will yet be given an opportunity of showing the public what you consider "satisfactory evidence" in such cases. Meanwhile the reason for the unfortunate position occupied by your organization in the eyes of the public will be better understood and 2,000 stockholders of Federal, including 700 women dupes, will rightfully conclude that it is idle to expect you to take any action calculated to protect those who have been robbed under the threadbare cloak of a supposed respectability accompanying official listing of a security on the New York Stock Exchange.

I regret that you have seen fit to ignore the plain rules of justice, but confess it was nothing more or less than was expected by me or by those associated with me. I am leaving in a few days for a month's trip to the West and trust that I shall not again be treated with the unfairness which characterized your conduct in this matter during my previous absence from the city.

ANSWERS TO CORRESPONDENTS

Mines and Methods receives a great many inquiries concerning mining propositions and requests for advice or enlightenment on various matters during each month. Some of these require personal replies, while others might just as well—and with all propriety—be made public. Therefore, readers of this publication who ask questions and seek information that can just as well be handled in this department, will find their answers here.—Editor.

New York, May 29.

I have just been going through the handsomely printed annual report of the Utah Copper Company. In the large photographic presentation of the steam shovel workings above the deep hole in the foreground it looks to me as though some of the numerous grades or banks on which steam-shoveling has been done were caved and that these grades or levels had been restored by the help of brush or pen or in "retouching" the negative. Do you believe that such is the case, and if so, why was it done?

E. M. J.

Mines and Methods has repeatedly told of the loss of steam-shovel benches by caving of the precipitous mountain side and the wrecking of steam shovels. A picture that did not cover up such palpable marks of managerial folly would have no place in an annual report designed to impress the shareholders and the public with the belief that criticism of this method of mining at the property was vicious and unjustifiable.

* * * *

Boston, June 3.

It was a great surprise to me to learn through your publication that D. C. Jackling was retiring as general manager of the companies with which he has been so prominently identified. Your criticisms of his policies and abilities I have always felt sure would eventually be shown as unworthy, unjust and uncalled for; now I don't know what to think. Did he retire voluntarily, or was he asked to resign?

Wm. McA.

We dislike to encroach upon the legitimate prerogatives of others and would therefore suggest that our Boston correspondent fire his query to the Boston News Bureau, or the Boston Commercial, either one of which we are sure—while they have studiously avoided saying a word about it—can tell precisely why the candle snuffer was dropped over the spot light in which Mr. Jackling's brilliancy has been intensified so long If neither of these publications are footfree enough to tell you call on us again and we shall be pleased to advise you.

* * * *

Salt Lake June 14.

According to one of the local daily papers Hayden, Stone & Co., in their notification to Alaska Gold Mines stock subscribers that the second payment of $5 a share will be due July 1, state that on the surrender of receipts for the first $5 paid and a check for the other five, "elaborately engraved stock certificates" will be issued. What do you suppose was the object in referring to the certificates as being "elaborately engraved?"

—Subscriber.

Our idea is that the intention was to impress on the subscriber the fact that it was not the purpose to take his $10 without giving ANYTHING of value in return.

* * * *

New York, June 16.

The word is being passed along here that a tremendously rich strike has been made in the Alaska Gold Mines Company's property. It is said that sixty feet of $4 ore is being rapidly developed and that the news is being reserved for release upon the return of Vice-President Jackling who is now said to be on his way to the property. Do you think we are getting the right tip? —E. E. & Co.

That such a report may be released upon the return of Mr. Jackling we have no reason to question. Alaska Gold is being touted by insiders as "the best thing we ever had"—and maybe it is, but that would not be much of a recommendation for it as an investment. And if you think you can speculate in it and get away without burning your fingers, just try it. "Startling disclosures" ought to be made with systematic regularity at the Alaska Gold mines from now on and the original 50,000,000 tons of $1.50 ore ought easily to expand to 200,000,000 tons of $3 ore within a year and to 600 000,000 tons of $5 ore within two or three years. It will have to do that well if it outshines the records of the low-grade porphyries promoted by the same community of interests—and we understand the mountains back of Juneau are large enough to supply a limitless tonnage of rock more or less valueless.

———o———

In its review of April operations at the Utah Copper Company's property the Boston Financial News had this illuminating comment to make: "Some rather significant results have recently been obtained in the retreatment of the low-grade concentrates by a flotation process based on that in operation at the Butte & Superior. In case further experiments prove satisfactory, the management believes that by means of this process it will be possible to affect a saving of from $250,000 to $500,000 annually in smelting charges." The Utah company's troubles in this respect were fully ventilated in last month's issue of Mines and Methods; previous to that time there was nothing in the published reports of the Utah company to create the slightest suspicion on the part of the public that there was anything wrong with the grade of concentrates produced at the company's "most perfect" milling plants. But the company's milling troubles are not the only ones, as was clearly shown last month. The property holdings of the company are running mighty short of the kind of ores that will produce a profitable concentrate under the long-term contract entered into with the Guggenheims and, while it is commendable that the present management should seek a means of doing better mill work, it is certain that the original blunder of falling into the smelting contract trap can not be counteracted through anything but a repudiation of that contract, and whilst the Guggenheims are the heaviest holders of Utah Copper shares, and in full control, it is not to be expected that they will relinquish the strangle-hold which their smelting contract gives them over the much greater, but scattering, interests in the Utah Copper Company.

———o———

A news item from New York early in the month stated that the $15,000,000 convertible bond issue of the Guggenheims' Chile Copper Company had been "privately subscribed." In other words, the public declined to bite. Verily, the name of Guggenheim has lost its magic.

———o———

It is said that Mr. D. C. Jackling is to go on the board of the General Petroleum Company; presumably Hayden, Stone & Company have been enlisted in the campaign for financing this rapidly growing newcomer among California oil companies.—Mining and Scientific Press, June 21.

How the mighty have fallen.

———o———

The mineral nemalite is a fibrous variety of bucite, a hydrate of magnesium. It is translucent and occurs in slender fibres, which are elastic and easily separated. Its color is white, with a tinge of yellow. It has a silky lustre.

———o———

If diamond-drill rods are greased with melted tallow or other suitable lubricant and then coated with Stockholm tar, it will be found that the tar will make a smooth lining in the hole which tends to prevent caving, says W. H. Trewartha-James (Bull. No. 95, I. M. M.). In some cases, particularly where there is sulphur in the strata, the casing thus formed is almost as hard as cement.

Formation And Growth Of Disseminated Copper Deposits (II)

By JAMES O. CLIFFORD.

In considering the structural relations of the rock series of a disseminated low-grade copper deposit it is pertinent to observe, as outlined in a previous paper, that two conditions are primarily essential; that is, the original mineralization generally is coextensive with areas of igneous intrusive rocks, or the metamorphic derivatives thereof, and that in order to afford an opportunity for the processes of enrichment to be carried out the mineralized area must necessarily be exposed to weathering agencies. Whether we consider a condition of absolute localization or of uniform dissemination of the original ore deposition matters little, as the ultimate result in the matter of secondary mineralization by enrichment will be the same, or nearly so. Thus, if we assume the original mineralization to have resulted in the formation of localized ore deposits of copper as replacements in the overlying sediments, as contact-metamorphic deposits, or as fissures—a condition which naturally would occasion an impoverishment of the mineral content of the magmatic mass as a whole—or whether the intrusive mineral-bearing mass retained its content as a uniform dissemination of original ore, the ultimate result in the matter of secondary enrichment would return the same result. This condition perhaps is best illustrated from the fact that the quantity of mineral carried to the surface by the magma would be definite, and the question then would be one merely of the mode of distribution at the time of original mineralization, dependent, of course, upon the physical and chemical conditions obtaining during the period of intrusion relatively to the rock composition.

GENERAL STRUCTURAL RELATIONS

The general structure of the so-called porphyries seems to follow a well-defined line in that they represent a condition wherein the over-lying rock series (generally sedimentaries) were domed up through the intrusion of acid or basic igneous rocks, resulting in the mineralization of the rock mass either as localized or disseminated ore-bodies, or as a composite of both. Types of both completely localized and of thoroughly diseminated deposits are common throughout the world, and it is not infrequent that they show evidence of the composite condition. However, in view of the circumstances surrounding the period of original mineralization as evidenced in numerous cases, the general condition seems to have been a localization of ore deposits with fractional dissemination, rather than the converse. This is true particularly where remnants of the overlying sediments containing ore deposits of the replacement type have been partially preserved, plainly evidencing a condition of impoverishment of the underlying intrusive responsible for the mineralization.

In many instances, due to the absence of the complete rock series, the assumption naturally obtains that the original mineralization represents a complete dissemination of mineral through the agency of the igneous rock, whereas, in fact, such a condition did not exist, but through later adjustment of the igneous rock affording channels for the percolating solutions, enrichment was brought about in a manner simulating complete dissemination.

For this reason it seems inadvisable to consider the "porphyries" under a common classification as disseminated deposits because the factor of original deposition should take precedence rather than subsequent, or secondary mineralization. It would seem that, under the circumstances, there is no direct law of rock classification, and while selective association (in which each mineral prefers or tends to occur in certain rocks rather than in others) is now a thoroughly recognized law, the more plausible view seems to be that the metal follows its own law of segregation rather than that of the rock segregation. It follows, therefore, that the occurrence of copper mineral as a dissemination in monzonites and quartz porphyries is directly not a criterion governing its absolute genesis, but rather a condition obtaining due entirely to the position of the rock series in any particular deposit relatively to the original mineralization of the superincumbent areas.

In any event, and considering the theory as advanced at present, the essential conditions necessary to the formation of zones of secondary enrichment as a disseminated deposit are strong faults and minute fracturing of the intrusive igneous rock across all horizons, resulting in the formation of zones of complete brecciation. The occurrence of large and well-defined fissures plays a very important role as evidenced in the formation of zones of secondary enrichment in unusual development. These conditions may have occurred at the time of original mineralization, or at a later period through adjustment of the rock mass, but in either event the ultimate result, insofar as enrichment is concerned, will be the same.

LOCALIZATION OF ENRICHMENT.

Synclinal folds play a most important part in connection with downward enrichment of disseminated ore deposits relatively to the condition of mineralization wherein the anticlinal fold represents the original deposition, inasmuch as the side of the basin problem considers the transportation of minerals in solution from the upper area to a lower horizon. For example, we may consider a condition very common among the porphyries wherein the sedimentaries were domed up by a granodiorite intrusion resulting in mineralization, as hereinbefore mentioned. Then through subsequent degradation of the upper exposed area its contained mineral was subjected to weathering resulting in complete oxidation and transportation (in solution) to a lower horizon, the process being continued till the original intrusive rock was itself exposed and subjected to the same treatment. Dependent upon the extent of faulting, fissuring and brecciation of the rock mass, enrichment would follow the line of least resistance.

In the absence of strong faults and strong fissures, but under a condition of complete minute fracturing, the natural result of enrichment would be the confinement of the descending solutions in part to a definite area resulting in the formation of a uniformly disseminated deposit. On the other hand, in the presence of faults and fissures, the natural tendency of the downward percolating solutions would be to concentrate therein and form localized bodies of secondary enrichment. However, under favorable conditions the drainage lines of the ridge exert considerable influence upon the descending solutions relatively to the respective slopes thereof. Assuming no outlet of magnitude intervening between the top of

the ridge and the two bounding valleys it is pertinent to consider the condition of a concentration of solutions underneath the main drainage line of the basins rather than on the side of the basin; provided, of course, that the topography is sufficiently mature and has had time to permit the concentration of solutions under the central drainage lines, and further, that the copper solutions down the axis of the valley have not been diluted to the point that they will not precipitate in quantities sufficient to produce commercial orebodies.

TOPOGRAPHIC AND CLIMATIC CONDITIONS.

Topographic and climatic conditions are very important factors in the development of a commercially valuable disseminated copper deposit. Extreme youth of an area representative of original mineralization, when accompanied by intensive erosion of the surface, results in a very slow enrichment due to the fact that the necessary processes are not allowed to be completed before the material is removed; consequently, if enrichment is at all evident generally it is confined to the upper horizons and is merely superficial. Ordinary youthful topography, assisted by reasonably vigorous erosion of the surface, affords a better condition, while a thoroughly matured topography results in enrichment under the drainage lines. Influencing factors are changes in topography and general structure of the rock mass through subsequent regional earth movements, and it may happen that after a partial completion of enrichment over a given area that there has been a change which will afford either better or worse conditions relatively thereto.

An essential condition seems to be considerable variation in climate over long intervals of time. Semi-arid to arid climates afford satisfactory conditions under certain circumstances. Wide variation of temperature and sufficient moisture accompanied by relatively high temperatures accelerate decomposition of the exposed surface. In this connection it is pertinent to observe that these conditions are the more nearly met in the semi-arid or arid regions than elsewhere, chiefly at altitudes ranging from 4,000 feet and upward above sea level.

PHYSICAL AND CHEMICAL CONDITIONS.

Rock composition generally is the controlling factor governing secondary sulphide enrichment. Dependent upon the power of resistance to physical disintegration orebodies will be formed relatively to the structural conditions surrounding the rock mass. If the intrusive igneous rock, or its metamorphic derivatives, present a compact, unyielding mass not readily amenable to the weathering agencies, it is not likely that enrichment will extend to any great depth; in fact, there will be little or no change in the original mineralization as represented therein. On the other hand, where the rock mass presents a physical structure susceptible to disintegration through weathering processes the condition then is conducive to the formation of secondary sulphide deposits. This is best illustrated, perhaps, by the fact that, where the composition of a rock mass of original mineralization is such that it is subjected to physical disintegration and chemical alteration by exposure to weathering agencies, the exposed portion containing original minerals will be thoroughly oxidized and the copper mineral content thereof in part carried to a lower horizon as an enrichment product, leaving a leached zone of barren capping on the surface proportionate to the intensity of oxidation.

Where conditions are favorable, and the original mineralization carried a relatively high iron pyrite content, it is not unusual to note outcrops of leached areas of capping, or barren rock, composed chiefly of impure hematite representative of the superficial alteration of the exposed surface of the mineral deposit. Generally the more hematite the capping shows, the more iron sulphide will be found in the fresh ore at a lower horizon. Often the residual products of pyrite oxidation are carried by surface waters into adjoining porous rocks impregnating them to the extent that they simulate the original leached area. It follows, therefore, that the apparent area of superficial alteration represented by the iron capping does not indicate the existence thereunder of an enriched zone, only as referred to the original copper mineral content of the mass relatively to the structural conditions obtaining.

Altered areas represented by iron capping do not invariably indicate zones of copper sulphide enrichment, nor is it necessary that there be present any iron capping whatever, as many large deposits show merely inconspicuous outcrops of rotted rock. Finally the principal conditions necessary are the mineralization of the original rock mass; the physical structure thereof; topographic and climatic conditions favorable to the complete degradation and transportation by progressive action of the copper minerals in solution to a lower horizon, there to be precipitated either upon leaner pyrite in the formation of workable bodies of secondary sulphide enrichment, or else, in the absence of primary pyrite, as secondary carbonates and silicates.

GENERAL CHEMICAL PROCESS.

The oxidation of a deposit of sulphide ores is practically the same regardless of the form or character of the deposit. The solution of the sulphides generally is in the nature of sulphates, resulting in the precipitation of the metals at a lower horizon in the form of secondary sulphides. The reduction of the sulphates to metallic sulphides may be accomplished by several different processes, but most frequently by carbonaceous matter, precipitation by hydrogen sulphide, or the reaction of the metallic salts with the unoxidized sulphides below water level; in which event the latter go into solution as sulphates (or other salts), the former precipitating as sulphides.

The first reaction considers that of the oxidation of the original sulphides. Aside from the exposure thereof to the action of atmospheric oxygen and moisture, strong oxidizing agents, such as ferric salts, play an important role. Relative resistance to oxidation and solution is an important contributing factor, and it may happen that chemical action is slower than the physical in which event the partially decomposed original product might be carried away before its contained copper content has been thoroughly leached and carried downward. Further, the chemical and physical composition of the gangue minerals may be such as to make them exclusively the determining factors.

IRON SULPHIDE A FACTOR.

Where pyrite is the predominating sulphide of the original mineralization its products of oxidation are particularly essential as reagents in the enrichment process. There are several ways by which reduction of the pyrite to ferrous sulphate is accomplished: (a), by oxidation solely by atmospheric oxygen, resulting in the formation of ferrous sulphate and free sulphur; (b), reduction to ferrous sulphate, and formation of sulphur dioxide, and (c), a more complete reduction by combined free oxygen and water to the ferrous sulphate and sulphuric acid. In the presence of an excess of sulphuric acid the ferrous sulphate, assisted by free oxygen, results in a further reduction to ferric sulphate. Ferric sulphate, however, is unstable near the surface, but at lower horizons (and assisted by other ferric salts) becomes an active oxidizing solution. Consequently the instability of ferric sulphate near the surface, and the active evaporation attending its presence, results in its forming a product consisting of the various hydrated

oxides of iron. The oxidizing action of ferric sulphate at lower horizons in the presence of water results in its breaking up into two molecules of ferrous sulphate, one of sulphuric acid, and a free atom of oxygen to attack oxidizable substances.

Considering the chemical changes that would take place when copper sulphate comes into contact with iron sulphide, the copper sulphate is reduced to cupric sulphide with the formation of ferric sulphate and the liberation of free sulphur, the ferric sulphate would in turn easily be reduced by hydrogen sulphide or free sulphur. The presence of hydrogen sulphide, resulting from the attack of free sulphuric acid on pyrite would result in the formation of the cuprous sulphide. However, in the direct formation of cuprous sulphide from an assumed solution of copper sulphate it probably would be more reasonable to consider the reactions as obtaining only between copper sulphate, iron sulphide and water; in which event a direct reduction to cuprous sulphide would be brought about with the formation of ferrous sulphate and sulphuric acid with no liberation of free sulphur. The exact chemical reactions governing secondary enrichment will never be written, but some light may be shed on the subject by means of the results obtained in laboratory experiments.

Little attention has been given the subject of the important influence of sphalerite as an active mineral constituent in the chemical reactions governing sulphide enrichment. That it plays a very important role in the case of many of the "porphyries" is well known, but investigations have not been sufficiently thorough to afford much data on the subject.

While thus far we have considered only the relative reactions between metallic sulphides, if we assume the solutions of the original leached area to have been copper bicarbonate instead of copper sulphate results will be obtained wherein the iron will form as a carbonate in lieu of sulphate. However, if the downward percolating solutions carrying copper carbonate do not encounter sulphide precipitants they will not form sulphide deposits at any depth. In consideration of this it will readily be appreciated that the chemical reactions governing the process may be acid, basic, or neutral and as there is no fixed rule in connection with the formation of downward sulphide enrichment deposits other than that above outlined each individual deposit must be considered independently.

Sand Filling As Support Of Mine Workings

By Al H. MARTIN.

The extraction of pillars of rich ore, and permanent support of the old workings, has been a problem for most mine managers from the days of comprehensive lode mining. The most general practice has been the close timbering of heavy ground with expensive timbers, but this has prevented in most instances the subsequent mining of portions of the ground, and compelled the management to abandon numerous pillars of rich quartz, as the timbers have needed the support of the column of rock to sustain the tremendous weight of the hanging-wall. Not only has the adequate support of the underground workings compelled the constant attention of the manager during the active life of the property, but even after the passing of its productive period, because of surface disturbances. The subsidence of the old mine workings has often endangered portions of towns and cities, and legislation has been frequently threatened against the mine owners to prevent trouble of this character.

The finest grade of timber is certain to weaken and collapse under the crushing strain of millions of tons of settling earth in the course of years even when supporting pillars are permitted to carry the greater portion of the strain. In many of the Rand mines, and numerous American properties, it has been found that the ore pillars show decided signs of crushing after carrying the prodigious weight for some years, even with the reinforcement of close sets of timbers. This is particularly marked when the vein-system has a fairly steep dip. Various expedients have been proposed to overcome the problem, and in several instances efforts have been made at its solution by employment of steel timbers, and reinforced concrete supports. Objections to such practices have developed, but the method has generally proved satisfactory when compared with old-time provisions.

It has fittingly remained for the great Rand mining field of the Transvaal to devise and perfect a method at once satisfactory and inexpensive—a method that has so convincingly demonstrated its merit that its use is becoming general throughout the greatest gold field of the world. On the Rand mining is conducted on a stupendous scale hardly appreciated in other fields, and the question of adequately supporting the mine workings at low costs has developed into a vital consideration. Practically all the premier companies have devoted special attention to the subject and after years of systematical experiments sand-filling has been selected as the ideal solution of the vexing question. The employment of the method has been particularly marked during the past two years, and its use is making rapid advances throughout the entire field. The success of the experiment on the Rand has claimed some attention from American operators, but is deserving of a better reception than has been generally extended it on this side of the hemisphere. American mine managers are proverbially slow to adopt the practices developed in foreign fields, which may account for the apparent indifference accorded the method developed by the Transvaal operators.

One of the most successful of the sand-filling plants on the Rand is that operated by the Witwatersrand Deep, Ltd., which has been in commission about eight months. The plant was designed after the method had been thoroughly tried out by several other operators, and embodies all the good features of earlier installations, together with many original improvements of merit. The mill of this company crushes about 38,000 tons of ore per month and 60 per cent of the reduced product is sand, or approximately 22 000 tons. All of this is turned back into the mine for filling of the old stopes and other workings. The Witwatersrand Deep claims are traversed by the great East Rand dike which practically cuts the property into north and south sections. In both portions of the mine sand-filling is proceeding, and not only has it facilitated removal of the rich pillars hitherto employed as supporting agents, but also enables the operators to mine large areas of ground formerly inaccessible under ordinary working conditions. The sand is sent from the surface into the northern portion of the mine through a hole bored for the purpose, and the south section is supplied by way of a winze.

METHODS EMPLOYED ON THE RAND.

At the receiving terminals are placed rows of tanks commanding belt-conveyors. These deliver the product of two

sludge pumps where the sand is mixed with about four times its own weight of water. In this state it is too wet for direct loading into the workings and first passes to the dewatering station where six Caldecot dewatering cones, for each station, reduces the moisture to about 28 per cent. The amount of water to be used forms an important point, and varies somewhat in different properties because of natural conditions. Without a sufficient percentage of water the sand cannot be effectively delivered to the various portions of the mine, and if the amount of water is excessive it must be pumped out again. The quantity used at the Witwatersrand was decided on after a comprehensive series of tests, and has proven satisfactory in this particular instance. The cost attending surface handling of the sands are approximately the same as are entailed in dumping the residue, while underground costs are slightly over four cents per ton. It is thus readily apparent that the process is fairly inexpensive.

As a result of the installation the management states that the safety element has been materially increased, and damage to surface buildings by sliding ground virtually eliminated. It has also enabled the carrying on of operations on a larger scale, inasmuch as more extensive areas of ground may be worked at once without danger of caving. Besides it permits the extraction of columns of commercial quartz formerly left to aid the timbers in sustaining the weight of the hanging-wall. In the old workings of this property several of the pillars show signs of yielding to the excessive strain, and sand-filling has proven far superior to timbers in assisting the pillars in bearing the load, when it is not deemed advisable to extract the supporting columns. The operation of the sand-filling plant is practically automatic throughout, and requires little attention, save at the surface loading stations and points of application.

An earlier and likewise successful sand-filling plant is operated by the Cinderella Consolidated, one of the greatest of all Rand companies. To gain an adequate idea of the extent to which sand-filling has progressed on the Rand, and the extensive manner in which it is being utilized, a brief description of the Cinderella Cons. is appropriate. The mine embraces 2,100 claims in the East Rand section of the Main Reef field, with the holdings coursing along the strike of the reef for from 16,000 to 17,000 feet. The present main working shaft has an incline depth of over 7,100 feet. The company is sinking a new main shaft, the Central, which in many respects will be one of the most remarkable working avenues in any mining property in all the world. It has seven compartments, with inside dimensions of six by forty-two feet and will be eventually sent to a depth far exceeding the point attained by the old shaft.

The orebodies are of great size and carry usual Rand values, and late reports indicate an ore reserve considerably in excess of 750,000 tons. The reduction facilities consist of 100 1,650-pound stamps, three tube-mills and a comprehensive cyanide plant, giving a capacity of 22,000 tons per month. The company has experienced considerable loss and annoyance by so-called "air-blasts," the result of violent fractures and earth movements, a condition frequently attending operations in deep mines. The terriffic pressure of the superincumbent strata at such depths crushes down stopes and other workings, and the ground fracturing under the enormous pressure bears down timbers, supporting pillars and other sustaining devices. The rush of air naturally following the collapse of the workings gives the name to the "air-blast." In the deep mines of the Rand such an occurrence is not infrequent, and the Cinderella Consolidated temporarily lost three of its richest stopes in this manner less than a year ago.

CINDERELLA'S PRACTICAL SCHEME

The filling of Cinderalla Consolidated workings with sand is carried on through a wooden box launder, having inside dimensions of 11x12 inches, and carrying the sand to a total vertical depth of 3,900 feet when so desired. As the greatest strain from earth pressure is experienced at considerable depth, it is readily apparent that sand-filling is most frequently conducted in the bottom levels. The sand from the surface bins is delivered to the launder by a belt-conveyor, which replaces, the pipes and launder formerly employed for this purpose. The sand passes in a dry state to the launder, as tests demonstrated that when the sand contained more than four per cent of moisture it clung to the sides of the launder and speedily checked the flow of the material to the deep levels. The falling sand drops upon a sharply-inclined plate of iron, upon which a stream of water is directed. This forms a mixture which flows into a steeply pitched launder where the sand and water are more closely associated before passing to the pipes and launders which deliver the sand to the portions of the mine undergoing filling. The speed with which the filling is conducted, and the efficiency of the plant, depends largely on the amount of water constantly available for sluicing the mixture into the filling pipes and launders, as the delivery of sand from the surface bins to the shaft levels proceeds rapidly as long as the material is kept dry. In this state the sand drops freely down the box launder without touching the greater area of the box, but when the percentage of moisture exceeds five annoying consequences develop. A slight excess of moisture does not cause trouble provided the sides of the box are dry, but when seven per cent and upwards of water are present the sand adheres to the box, and its fall is naturally impeded. As the ratio of moisture increases the descent of the sand becomes correspondingly affected. It is for this reason that the sand should be relatively dry before using.

Attempts were at first made at the Cinderella Consolidated to overcome the clinging tendencies of the damp sand and increase its velocity by means of compressed air, but after repeated trials the attempt was abandoned as valueless. Another plan was the placement of a blower at top of launder, and establishing connections near the bottom with the intake of a ventilating fan, but this also was found impracticable, and the only satisfactory method proved the handling of a dry product.

Aside from the advantage derived by the employment of sand for filling, there is the additional one of reducing the amount of water to be pumped from a mine of average wetness. The sand sent into the Cinderella Consolidated has a moisture of three per cent and it is estimated that about 8,000 gallons of water are used in the mine each day in connection with the sand-filling work. Under other conditions it would be necessary to elevate this water 4,000 feet, consequently the employment of the practice lowers the pumping costs to a fair extent. The filling is in charge of an expert timberman, but the other work is performed by native and unskilled white labor. Total costs approximate five cents per ton for underground work.

The Cinderella Consolidated method differs considerably from the one employed at the Witwatersrand Deep, as readily appears upon examination. By the use of its apparatus the Cinderella Consolidated avoids the use of dewatering machines, but is under the necessity of maintaining an exceptionally dry product on surface. The method is favored by many Rand companies when continuous filling is not required, otherwise wet weather would greatly diminish its efficiency by making the sand too damp for rapid work. The simplicity of the Cinderella Consolidated

method is its strongest recommendation, aside from the excellent results obtained under favorable working conditions.

In using the Cinderella Consolidated method it is recommended that the sand contain not more than three to six per cent of moisture. Because of this it is inexpedient to use the sands direct from tanks, and the material should be exposed to the action of sun and air at least two days before using. This not only reduces the moisture sufficiently, but also neutralizes the cyanide or destroys its powers. Attempts were at first made by the inventors of this method to neutralize the cyanide with potassium permanganate, but it was found that the treated product when brought into contact with the ordinary acid mine water developed cyanogen gas. The presence of this terribly poisonous element in a mine must naturally be prevented, and it has been found best to expose the sand to the sun and air several days.

The box launder was adopted after several tests with iron pipes, and its success has been convincingly proven. It was originally intended to mix the sand and water on surface, the usual practice, and send the mixture down the shaft, but the excessive wear of the pipes, largely because of the great depth to which the product was carried, led to the contriving of the present method. The box launder should be placed in the driest of the shaft compartments on the down-cast side, and the outside tarred if sand containing as high as nine per cent water is used.

An exhaustive series of tests carried on by the Cinderella people conclusively proved that sand containing ten per cent and upward of water could not be advantageously used, because of the impossibility of keeping the launder free of the clinging material. Whenever the launder becomes choked with sand a stream of water is used to sluice it out. The ever present possibility of such an occurrence makes it essential that a dependable bell-signal service, or similar arrangement be maintained between the surface bins and the filling point, also that an ample water supply be constantly available for the clearing of the choked launder.

The rate at which the sand should be supplied depends to some extent on the experience of the labor, for it must not be fed too swiftly or it develops a tendency to crowd the bottom sections of the box, while it must be delivered at a sufficient speed to insure a good velocity. At the Cinderella Consolidated the launder is provided with observation doors at every 100 feet, enabling the operators to readily detect cause of any troubles that may develop. With sufficient water for sluicing and the sand fairly dry, there is little trouble in maintaining a satisfactory flow of the sand.

The process employed by the Witwatersrand Deep Co. is the one most generally favored by Rand operators, and may be considered a standard method of sand-filling. The sand is taken direct from the tanks, and the free cyanide neutralized by feeding potassium permanganate into the pulp. Tests of the treated product are made regularly to detect any trace of free cyanide and prevent its passage into the mine workings. It is essential that the sand used in filling be sufficiently moist to pack well, as a too dry product is more difficult to handle and flows through the supplying pipes and launders less readily. Yet the product must not be too moist, or the necessity of pumping out the excess water means loss of time and added expense.

While the management of the Witwatersrand Deep uses an admixture of seventy-two parts sand and twenty-eight parts water, the property is an exceedingly wet mine and the use of a very moist sand is carefully guarded against. The company is pumping about 1,500,000 gallons per day at present, and a few months ago was handling 2,000,000 gallons. The excessive wetness of this mine is attributed to the big transverse dike which cuts through a portion of the Witwatersrand Deep and neighboring properties. Within a short time it is expected the powerful new pumping system of the East Rand Proprietary company will relieve the Witwatersrand Deep of a considerable portion of the water, in which event it is possible the proportion of water used in the sand filling will be increased.

SAND FILLING SPELLS MINE SAFETY.

In many of the dry mines of America it probably would be found desirable to employ a mixture containing considerably more water to insure best results. Sand-filling may be carried on very much as ordinary timbering, as the timberman in charge of the work completes the placement of the sand in the workings as the ore is removed. In this way there is no necessity for leaving large open chambers unsupported for any length of time, and caves or movements of ground toward the shafts, are effectively controlled. The total costs of sand filling on the Rand varies from ten to twenty-four cents per ton, including surface handling. It costs about ten cents per ton to handle the sands from the tanks and store on the dumps in ordinary practice. It is thus apparent that the sand can be sent down to the mine levels almost as cheaply as it can be stored on surface.

The danger of caves in deep mines, and resultant airblasts of terrific severity, is intensified by the room and pillar method of mining and similar practices, and it is under such conditions that the use of sand for filling of the old working claims particular attention. The pillar and room method means large open spaces, and a large open stope is a source of positive danger. In many mines worked by this method the men labor under cover, the guarding pillars protecting them from sudden caves of the hanging-wall. The pillars are subsequently removed by top-slicing. But there is always the possibility of the ground crushing down the supports, unless a large number of pillars are provided. The method is dependent for success upon the bringing down of the capping evenly and regularly, and it is economically necessary that the maximum quantity of ore be caved down in the shortest possible period of time. The method has been developed along particularly successful lines in the Lake Superior district, and it is notable that airblasts are very common in this region.

As before stated an airblast is caused by intense compression of air in a confined space. The fall of an enormous tonnage of rock into a large empty stope hurls a crushing wave of compressed air through the mine very much as a similar wave is set in action by a gas or dust explosion in a coal mine. The rushing blast of air sweeps timbers, cars and men along with tremendous force, and such blasts have often caused heavy loss of life and considerable property damage. It is not to be concluded that airblasts are always the result of caving methods of mining, for disastrous blasts of this character have frequently occurred in more restricted workings. They were not unknown on the Comstock when that famous lode was at the zenith of its glory, and have developed in most of the deep mining regions of the world.

DESTRUCTIVE FORCE OF AIR-BLASTS.

A convincing demonstration of the terrific force of an airblast, and its deadly properties, was recently evidenced at the Miami copper mine, where three men were killed, seven seriously injured, and others hurt in minor ways by the swirling blast of air driven from 245-foot level by the collapsing of capping estimated to comprise 3,000,000 tons. In this mine the men work under protecting pillars, and the falling rock itself caused little damage. But the cave drove the compressed air forth at ter-

rific velocity, carrying death and destruction into the nearby drifts. The resistless nature of the blast was evidenced by the driving of a seven-ton motor and fifteen ore cars along the track for 200 feet, despite the desperate efforts of the motorman to check the terrific force of the rushing wind. In foreign fields the airblast has been a most destructive agent, and the frequent occurrence of such accidents on the Rand was one of the prime reasons for adopting the sand-filling method.

The danger of airblasts has been given little consideration by metal miners in the past, although numerous precautions have been taken to guard against the danger of falling masses of rock. The series of airblasts recently occuring in many districts, however, particularly in deep mines and where large stopes are worked, have awakened managers to the presence of an element of peril that must be guarded against as carefully as other potential sources of danger. It is universally conceded that the most dependable guardian against the airblast is an adequate support of the roof of the underground workings, but conditions are frequently of such a nature that close timbering is economically impracticable. In many districts timbers are difficult to secure, and costly to install, while the margin of profit attendant on mine production is so limited that the management does not feel justified in assuming further expenses.

Under the present exigencies of the commercial era, each mining company is endeavoring to rush production. Practically every progressive manager is striving to extract the largest possible quantity of ore within a specified time, and the earning of maximum profits forms the chief consideration. But such a practice has its draw-backs and penalties, and the insufficient support of heavy ground too often entails subsequent costs and delays.

When the lessons of Rand mining are studied and analyzed, and it is realized that the sand-filling method has only been adopted after years of comprehensive and intelligent trials by the leading Transvaal companies, it seems strange that the practice has not been given greater approval by American operators. The method was not employed by the Rand companies before its merit had been definitely established, and while most managers admit there are many opportunities for improving the system, it has incontestibly saved an immense sum to several operators, and facilitated extraction of ore from sections of ground previously inaccessible. Not only has sand-filling proven of inestimable benefit in protecting the mine from the effects of disastrous caves, but has also increased the important factor of personal safety whenever employed. And the human factor, the adequate protection of the employees, must be considered. Unless the miners know they are working in a fairly safe stope, with all possible precautions exercised to secure them from accidents, they cannot be expected to remain satisfied with conditions, nor to do their best work. No man can give his best, when he knows that danger constantly hovers near. And no man will work for long in a property he knows to be absolutely unsafe. Furthermore, it is the duty of the company to protect its men to the utmost of its ability. And as a means of protection the sand-filled workings have demonstrated their worth. The subject is commencing to claim some attention in America, and has been given a trial in some instances, but has yet to be given the support by the mining fraternity to which Rand results prove it to be entitled.

ELECTRIC FURNACE SMELTING

Elsewhere in this issue of Mines and Methods there appears an article on the subject of zinc smelting with the electric furnace prepared by Mr. Peter E. Peterson, mining engineer, of Butte, Montana.

It will be of interest to readers of this journal to know that the author conducted his experiments as therein outlined on the Butte and Superior property using, in part, ore and concentrate from that company's mine and concentrator for the purpose. The practicability of the furnace was fully demonstrated.

During the period of experimental operations by Mr. Peterson, and immediately following the inauguration of a new management represented by Utah Copper interests, the announcement was officially made that, in lieu of the treatment of Butte and Superior mine-run ore by established "wet" methods of concentration, a new "dry" process would be installed, which latter would afford a production cost for spelter lower than that obtaining elsewhere in the mining world. The "dry" process mentioned, so we are informed, considered the treatment of the mine-run ore in the electric furnace and the direct production of refined spelter on the property, thereby eliminating the necessity for a preliminary ore-dressing and shipment of concentrate to eastern zinc smelteries for further refining. Though negotiations had been entered into between the management and Mr. Peterson for use of the electric furnace process, later they were declared off. Then followed the "remodeling" of the original efficient concentrating method by installing the "Garfield" system of milling—as outlined in earlier issues of this journal—which in turn was abandoned.

Ways and means should be devised at every mine, large or small, to determine, at least approximately, what the value of its product is before shipping. Whether this knowledge is gained by actual sampling of the ore in the mine before it is broken, or afterwards, by various methods usually employed, will depend on local conditions.

Breathing can usually be restored after an electric shock within an hour, says Coal Age. Keep up artificial breathing for this length of time at least After breathing starts, begin to restore the circulation by rubbing the limbs briskly in the direction of the heart and under the covers with which the patient has been previously covered.

The fire-fly produces light in a very efficient way. The spectrum of the emitted light consists of a narrow band in the yellowish-green portion of the visible rays, apparently unaccompanied by any emissions in the ultra-violet or ultra-red portions. When oxygen is absent no light is given out, and the light is not necessarily connected with the life of the insect. The abdominal material, when dried and powdered, may be kept for two years, and it will then emit light if moistened and exposed to oxygen. As yet chemistry has been unable to duplicate this result.

Rain-water collected after a long period of wet weather is the most natural water. It contains atmospheric air and gases in the proportion of about 2.5 cubic inches to every 100 cubic inches of water. River water is the next purest, then comes the water of lakes, ponds, ordinary spring and mineral springs. Following these waters comes arms of the ocean lying in the vicinity of the mouth or discharge of great rivers, then follows the water of the main ocean and last of all the waters of lakes, like the Dead Sea, Caspian Sea, and the Salt Lake of Utah. Spring water although perfectly transparent contains more or less mineral matter dissolved in it. The nature of these impurities will depend on the character of the soil through which the water percolates. The most general impurities are carbonate of lime, common salt, sulphate of lime (sometimes called gypsum) sulphate and carbonate of magnesia and compounds of iron Most spring waters contain a certain proportion of carbonic acid gas.

THE ELECTRIC FURNACE FOR SMELTING ZINC ORES

By PETER E. PETERSON.*

From the nature of the present retort method of recovering zinc from zinc concentrates it is almost impossible to conceive of any improvement therein

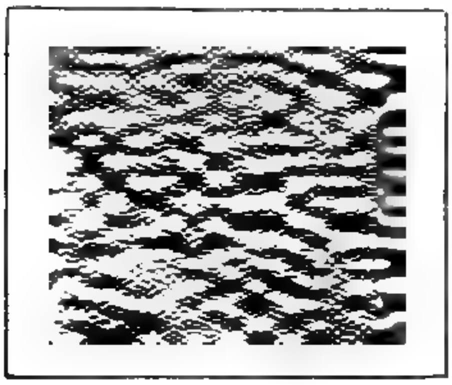


Fig. 1.

that would lead to increased capacity and decreased costs, let alone the possible recovery of zinc from the abundant complex zinc ores (containing copper, gold, silver, lead and iron) at a reasonable cost and appreciable recovery of the other metals.

The metallurgy of zinc is one of distillation. The zinc must be vaporized at a high temperature, and in a reducing atmosphere. Outside of the retorts the electric furnace is the only smelting device that can meet these conditions, and seems to hold out the only hope for improvement in zinc smelting.

The possible apparent advantages are: Large units continuous feed and discharge and the recovery of gold, silver, copper and lead in the form of copper matte or lead bullion.

The problems encountered in building a furnace to make the above advantages a reality have been many, and perhaps much time and work can be saved to others by a discussion on different types of furnaces employed.

THE FIRST FURNACE.

Fig 1 shows a vertical section of the first furnace experimented with. This furnace had no opening to the outside, although there was some leakage of gas around the upper electrode. The charge consisted of mixture of zinc sulphide, copper sulphide, lead sulphide and iron sulphide, and sufficient metallic iron to desulphurize the zinc sulphide ($ZnS+Fe=Zn+FeS$). The furnace was connected to small direct-current generator and run at the rate of 4 kws. per hour, the amperes varying from 40 to 50

There was no way of telling when the charge was smelted, so a series of runs were made ranging from 1 to 3 hours. At the end of 3 hours the charge was completely smelted The resulting matte showed from 1 to 2% zinc and small shots of metallic lead, while 95% of zinc in the charge was recovered in form of a high-grade spelter assaying 99.8% zinc. The 3-hour run was repeated and practically the same results obtained. Another furnace was built with a condensing chamber on one side with a small opening for escape of gases. With this furnace it was not possible to condense the zinc to spelter, it being condensed in the form of blue powder.

LARGE FURNACE BUILT.

Results with these small furnaces were so encouraging (and there seemed to be

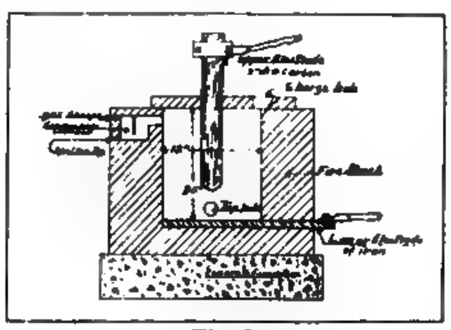


Fig. 2.

no difficulties in condensing the zinc) that a larger furnace was built along the same lines. This furnace was constructed of ordinary fire brick having walls 1 foot thick and a smelting chamber 1 foot square and 2 feet high. The top consisted of slabs of fire brick 2 inches thick with a charge hole and an opening for the electrode. The bottom electrode was a block of iron having a cross-section of 1 inch by 12 inches, extending through the wall and protruding 8 inches The vertical electrode was a carbon rod 2 inches in diameter and 4 feet long. This furnace had a rectangular condensing chamber 6 by 6 by 12 inches with a baffle running the long way, causing the gases to circulate first down one side and then up the other. There was a small opening ½-inch in diameter at one side of the condenser for the escape of gases. (See Fig. 2).

The furnace charge used consisted of unroasted zinc concentrate analyzing as follows 47.81% Zn. 9.21 insoluble, 6.2% Fe, 1.5% Mn, 30.32 S, 1.4 Cu, 0.035 oz. Au and 12.2 ozs. Ag. Scrap iron was added to desulphurize the zinc

The power was obtained from 50-kw. alternating transformer The electrodes were connected to 110 volt circuit, and in series with the circuit was packed a choke coil to protect the transformers in case of short-circuit, and at the same time to somewhat regulate the current.

Numerous runs varying from 4 to 12 hours were made The condensing arrangement failed to condense anything but blue powder. The furnace consumption was irregular, and consequently the heat was the same. Attempts were made to tap the furnace, but were not very successful, although some slag and matte was tapped which analyzed as follows: Slag—Zn 4%, Cu 0.19%, FeO 11.1%, Au trace, Ag .35 oz. Mn 0.6%, SiO_2 64.65%. Matte—Zn 1.3%, Fe 60.4%, S 29.35%, Au 0.03 oz., Ag 9.4 ozs., Cu 1.70%. The analysis of the slag and matte is interesting and showed the possibilities of the process.

CHANGE IN CONDENSERS.

The furnace was next equipped with a 2-inch iron pipe, 2 feet long, for a condenser. This pipe was flush with inside, and stuck out a foot into the air. With this arrangement it was possible to condense some spelter after an hour's run, which allowed time to heat the condenser up to the condensing temperature At this stage of the experimenting

Fig. 3.

it was evident that for successful condensation of volatilized zinc to spelter, there must be some way of controlling the temperature. The next experiment

* Mining Engineer Butte, Montana, in Mining and Scientific World

consisted of a 2-inch iron pipe 6 feet long, extending across the top of the inside of the furnace with series of holes bored into the upper side of pipe for the admission of zinc vapors, the theory of the apparatus being that with a long pipe,

Fig 4.

one end cold the other hot, between these two temperature extremes there would always be a zone of the proper condensing temperature.

This condenser gave fair results. Starting the furnace cold at the end of an hour, it was noticed that condensing commenced and would continue at a good efficiency for an hour; when the condensers seemed to get too hot, or rather the zone of proper condensing temperature was greatly reduced in area. Various means were tried to increase the length of this condensing zone.

A larger pipe 8-inches in diameter was inclosed with brick and heated with coal. Clay tubes of varying lengths and thickness were tried. Iron pipe insulated with varying thickness of asbestos, and chambers of varying dimension in the wall of the furnace, was experimented with, but none of these gave better results than the 2-inch pipe 6 feet long.

The problem seemed to resolve itself into three parts; that is, a certain temperature was found to be necessary as well as a certain area, and that this area must not be too far away from the source of distillation. In other words, the zinc must not be kept in a vapor form too long before condensing. The furnace seemed to stand up well, except the cover, and this usually did not last more than a couple of days.

FURTHER DEVELOPMENT.

The bottom electrode, although of iron, gave no trouble, which was no doubt due to the shortness of the runs. Up to this time there was no very definite idea of costs, such as electrode and power consumption, so another furnace was built of the same type and an effort made to run a ton of zinc concentrates in one run, keeping careful record of the power and electrode consumption, disregarding entirely the condensing of the zinc to spelter. This run was in two parts, one using metallic iron as a reducing agent and the other using lime and coke, according to the following reaction: $ZnS + CaO + C = Zn + CaS + CO$.

The following results were obtained:

Reducing agent—	Iron	Lime and coke
Kw-hours consumed	360	388
Pounds ore smelted..........	455	363
Pounds reducing agent.	193	197[1]
Total pounds of charge..	648	560
Kw-hour per pound charge....	556	692
Kw-hour per pound zinc contrates	79	1.07
Kw-hour per ton zinc concentrates	1580	2140
Kw-hours per ton zinc concen-		
Per cent of zinc extracted obtained by difference	90	50

[1]164 lbs. lime, 33 lbs. coke.

The above test using iron as a reducing agent, was made in three separate runs, the furnace being allowed to cool down between runs. In using lime and coke the furnace was allowed to cool down four times. Copper coated carbon electrodes, 3 inches in diameter were used, and the carbon consumption per ton of zinc concentrates was 12 lbs. This furnace was lined with magnesite brick. The run did not show them to be superior to fire brick. Under these conditions the cover of the furnace suffered the most and had to be replaced twice. The power consumption varied greatly, and it required constant moving of the electrode by the operator to keep the furnace running. The furnace was charged once an hour by means of hopper with a slide in the bottom. Immediately after charging the zinc vapor issued from the ends of the condenser with great velocity, due to the small amounts of moisture present. The charge was not preheated as it should have been. There was no separation of slag and matte. An analysis of the material tapped from the part of the run using lime and coke for reducing agent is as follows:

% Insoluble	% FeO	% S	% Zn	% CaO
8.6	13 2	24 3	24.3	25 1

Fig 5.

At this time it was decided that the most economical method of treating zinc concentrates cou'd be attained by roasting them to oxide, but leaving sufficient sulphur to form a matte as a collector for the precious metals. After some experimenting the practicability of the following reaction was proved:

$Fe_2O_3 + 3C + 2ZnS = 2Zn + 2FeS + 3CO$.

By this method the major part of the zinc is reduced from the zinc oxide by carbon, and the zinc in the sulphide form is reduced by iron, which has been reduced by carbon from iron oxide.

THIRD FURNACE BUILT.

The next furnace constructed was to have a capacity of 1 ton of roasted zinc concentrates per day. The furnace was a radical departure from anything previously tried. The charge was fed into the furnace through the upper electrode so as to introduce it directly into the arc. There were eight clay condensing tubes inclosed by heavy brick walls with an arrangement to cool the tubes as rose above the condensing temperature. (Fig 3 shows drawing of this furnace).

The condensing tubes being inclosed in heavy brick walls, it was thought that in time, about two or three days, the condensers would become over heated from the zinc vapors, and then it was proposed that the tubes be cooled to the right condensing temperature by air. This condensing temperature we were led to believe was between 450 and 515° C. Ingalls' book on Zinc Smelting gives these figures. Later this condensing temperature was determined to be above 864° C. This is also consistent with theory when it is considered that zinc boils under normal conditions at about 920° C.

CONDENSER DIFFICULTY.

After several runs lasting from two to six days it was found impossible to heat the condensers to 450° C. let alone 864°. The zinc was condensed in the form of blue powder as was to be expected.

The brick work in this furnace was put in with all possible care, yet frequent explosions resulted from the leakage of CO gases into the air chamber surround-

Fig 6.

ing the condensers. The openings were continually choking up with blue powder, and it was found rather hard to keep them clean. This character of condensing apparatus was too complicated to offer any success.

The expected improvements in smelting gave considerable trouble. The furnace was connected up without any regulating device to control the power, and as a consequence it was found impossible to keep a constant heat. The charge was intended to be fed continuously through the hollow electrode by a screw, but due to variance of fusing the feed was continuously choking. The object of charging in this manner was to obtain lower power consumption per ton of charge. This was accomplished.

MECHANICAL DIFFICULTIES

The power consumed was from 1,100 to 1,300 kw.-hours per ton of 50% zinc concentrates, but the mechanical difficulties still existed. The hollow carbons gave considerable trouble by breaking. Later graphite tubes were used which gave better results. The bottom electrode which was of iron, as in the former furnaces, melted and destroyed the bottom of the furnace with it. The furnace cover showed no deterioration whatever.

The furnace was remodeled. (See Fig. 4). In place of the iron electrode in the bottom a 6-inch diameter graphite electrode was substituted. The smelting chamber was reduced in size and a water rheostat was placed in series with the circuit as a means to control the power.

The condensing apparatus was replaced by three clay tubes 1 inch thick, 4 inches inside diameter and 5 feet long. These were placed in a shallow brick chamber open at the top. These condensers were covered with varying thicknesses of dirt, as it was thought necessary to maintain the condensing temperature. With this device some spelter was obtained. From 4 to 5 inches of each tube was doing the condensing, and the greater part of each tube was too cold to condense. The condensing apparatus was next replaced by eight tubes 1 inch thick and 4 inches inside diameter, all of different lengths varying from 14 to 28 inches, two of these tubes were of carbon; the rest were of clay, and two of the clay tubes were partially filled with charcoal.

The ends of these condensers were luted with clay, leaving about ⅝-inch diameter hole for the escape of CO gases and uncondensed zinc vapor. Pyrometers were constantly kept in the tubes. No zinc could be condensed unless the inside surface of the condensers was above 840° C., and at 900° the condensers were too hot. The carbon tubes condensed no better than the clay tubes; the clay tubes containing charcoal did not condense quite as well as tubes without.

At no time during this run was the zinc completely condensed for there was always uncondensed zinc burning at the ends of tubes, and at all times the condensers would condense spelter if the temperature was around 864° C. From these results it was concluded that each of the tubes had a limited condensing capacity, and if the tubes were kept at 864° C., and the amount of zinc volatilized kept within the limits of the condensing capacity of tubes, there would be practically a complete condensation of the zinc.

PRODUCES SPELTER

Another change was made in the furnace. Solid graphite electrodes 6 inches

Fig. 7.

in diameter were used in place of the hollow ones, and charge was introduced by means of a screw through one side and near the top of the smelting chamber. The furnace was run on barren charge until the condensers attained a temperature of 859° C., then a charge containing zinc was introduced and fed at a rate so that very little zinc appeared in the flames burning at the ends of the condensers. This maintained for 12 hours and the spelter condensed and recovered was 86.4% of the amount charged into the furnace. Thus at last

Fig. 8.

it was proved that spelter could be made with the electric furnace but it was observed that the power consumption was approximately 4,000 kw.-hours per ton of 50% zinc concentrates.

The furnace bottom was giving trouble; it melted out almost as readily as the charge. This complicated matters making slag thick and pasty, and only occasionally did any matte appear with the slag, but the matte was always found when a furnace was torn down. The bottom electrode was consumed at about the same rate as the vertical one. This and other reasons made the furnace exceedingly hard to control. The destruction of the furnace bottom was attributed to the arrangement of the electrodes.

The condensation of zinc requires constant conditions, such as a quite uniform flow of gases and a constant heat which could be easily varied. The next step was to improve the smelting part. A small furnace was erected with two electrodes through the top. (See Fig. 5.) These were placed about 6 inches apart. The inside of the furnace was lined with silica brick and the bottom covered 10 inches deep with siliceous zinc tailings from mill jigs. No efforts were made at the condensation of spelter, the zinc fumes passing into a flue and allowed to go to waste.

With this furnace numerous runs were made covering a period of 30 days. Slags of different composition were tried and the proportion of reducing carbon was determined. This work resulted in much useful information concerning furnace charges. We had no difficulty whatever in making slag and mattes and tapping them from the furnace, and the power or heat could be kept constant or varied at will with practically no attention. Test runs on recovery of metals and power and electrode consumption were very satisfactory. The furnace was torn down and showed practically no deterioration whatever, in fact part of the tailings from the furnace bottom were not altered.

CONICAL CONDENSERS.

A larger furnace was constructed along these lines fitted with eight conical condensers, such as used by the zinc smelters in Kansas and Oklahoma. A run was started and for the first 24 hours was encouraging. Then the old trouble returned. The furnace would not respond to regulation and no slag could be tapped. The apparent electrode consumption was enormous; 20 feet of 6-inch diameter solid graphite electrodes were fed into the furnace in six days time. Something was radically wrong, and on opening the furnace it was found that a hole 6 feet below the bottom had been melted out. The electrode consumption had been very little, the electrodes when removed were 12 and 14 feet long respectively. The trouble was caused by the arrangement of the electrodes. The operators in attempting to regulate the power had lowered the electrodes through the bottom of the furnace.

The hole in the bottom of the furnace was filled with siliceous zinc tailings, and the electrodes placed at such an angle of each other (see Fig. 6), that when lowered they would meet at the bottom of the smelting chamber. The screw feed was abandoned owing to the irregularity of air supply used in run-

ning in, and charging of the furnace was accomplished by means of a brick hopper with a graphite electrode for a slide in the bottom.

The furnace as now arranged was smelting during actual running time for thirty days with five stops, during which time the furnace was allowed to get cold. During these runs the previous condensing experiences were repeated without any improvement. The spelter that was condensed was found remarkably pure, assaying from 99.3 to 99.8% zinc. The furnace gave no trouble in any way. Slag and matte were tapped every twelve hours.

For the time being the efforts at improving the condensers were abandoned and arrangements were made to recover all zinc products. To accomplish this a new furnace was built, and special iron condensers were made to recover the blue powder; also a bag house was used to catch the zinc oxide in fumes. (Fig. 7 shows view of blue powder condenser.) A 12-day run was made without difficulties of any kind. The charge was fed in every hour, and slag and matte tapped every twelve hours. The metallurgical results will appear in another article.

This furnace in its present improved form is about all that can be expected of any furnace. There are far less difficulties encountered than in running an ordinary blast furnace.

The deterioration of the furnace is small. Such a furnace should run from six months to a year without any extensive repairs. Large units can be constructed by merely the addition of more electrodes, and there is no reason why units of twenty-five to fifty tons each could not be operated as easily and cheaply as the one-ton units.

In connection with the condensing experiments a small register type of furnace was constructed. (See Fig. 8.) This furnace was made with a view to duplicating the conditions existing in the present day zinc retort, with the exception that electrical heat was used instead of gas or coal.

The essential parts of the furnace were a rectangular brick chamber having a resister of graphite blocks in the bottom, connected to an electrode at each end. The arrangement of this furnace was such that the heat was always under control. There was one condenser of the same type as used in retort smelting. The furnace was charged intermittently with roasted zinc concentrates and coke and coal.

In operating this furnace great care was taken in regulation of the heat so as to have the same conditions as in the retorts. It was noticed that the zinc began to volatilize before the condensers were hot enough to condense it to spelter, and that after the condensers had reached the right temperature, there was more zinc volatilized than it would condense, and when the heat was reduced to cut down the volume of zinc vapor, the condenser would get too cold. This condenser when at the right temperature which could be easily maintained, would condense two pounds of spelter per hour with approximately the same amount of zinc vapor passing through without condensing. There could be no doubt whatever as to the gases being of the same composition as in the retort.

These experiments were repeated a number of times, and the results were always the same. And to me they prove conclusively that the failure to condense zinc to spelter in the electric furnace is due to the difficulties in maintaining sufficient condensing area at the right temperature near the source of volatilization.

In another article will be described a condenser designed to meet these difficulties.

MICROSCOPY IN ECONOMIC GEOLOGY

By R. BECK.*

The great advances which have been made in the systematic and genetic knowledge of minerals and rocks since the application of the microscopic method of investigation are well known. So numerous are these results that they can hardly be comprehended. But a limit has already been reached, beyond which a fruitful development of the science through this means alone is scarcely to be expected. After a surprising number of unlooked for constituents were shown to be present in the rocks and thereby entirely new points of view had been opened up to systematics, the investigation of the structure or the manner of intergrowth of the constituent minerals of rocks was brought into the foreground, and attempts were made to draw important genetic conclusions from these results. It was found, however, that the bulk chemical composition of rocks, which had fallen into comparative neglect after the introduction of the microscope, as contrasted with the preceding period of the hand lens, was a significant genetic factor. Chemical analysis was therefore again established on a new basis, and its results successfully applied to genetic classification. But even then the goal was not attained. Experimentation, especially fusion in the electric problems, began to attain general importance in modern petrography. But here also the microscope is necessary; for by means of it thin sections of the natural occurrences are compared with sections obtained from artificial melts. It is evident that in this field petrography frequently comes in contact with metallurgy and especially with metallography.

*This translation of the address delivered by Professor Beck on the occassion of his inauguration as rector of the Royal School of Mines at Freiberg, Saxony, October 3, 1911, was made with his permission by Joseph T. Singewald, Jr., of the geological department of Johns Hopkins University. The German title is "Ueber die Bedeutung der Mikroskopie fur die Lagerstattenlehre." It is reproduced from the Engineering and Mining Journal of May 31st.

EARLY PETROGRAPHERS NEGLECTED OPAQUE MINERALS.

Along the path of development which has just been sketched, petrography on the whole bothered itself but little with economic geology. The petrographers of the '70s and later, for example, treated with a certain disdain the disseminated ore minerals which are usually found as essential or accessory components of rocks. This is apparent in their vague designation of these as "opaque constituents." Different ores, as well as particles of carbon and graphite, were brought under this heading without further investigation. The fact was not heeded that these inclusions, in spite of their minute quantity, often plainly indicated the genesis of the rock in question. A miscroscopic investigation of the composition and structure of actual ore deposits was seldom attempted. Especially were the nonmetallic deposits avoided by the petrographer.

Happily, during the last decade these conditions have completely changed. Everywhere the importance of the microscopic method for the investigation of ore deposits of all kinds has been recognized, especially in the treatment of practical geological questions. Among the first and foremost in this work has been the Freiberg school of geologists, whose efforts have been rewarded with many important results.

It is not intended to relate here in chronological sequence the achievements of the microscopist in this field, but rather to give a review of the results that have been obtained, following in this the order of the systematic classification of ore deposits. The metallic deposits will first be taken up in accordance with the genetic classification in Beck's "Lehre von den Erzlagerstatten."

INFLUENCE OF MICROSCOPE ON CONCEPTION OF MAGMATIC SEGREGATION.

In the very first genetic group, the magmatic segregations, we see that the microscopic apearance of a specimen often alone determines the entire conception of it. It is relatively easy to examine an ore which contains only one ore mineral in addition to the silicates and other minerals which are transparent in thin section. To distinguish several opaque minerals from one another is more difficult. For this purpose reflected light is being used with great success by means of a simple vertical illuminator, or even by direct cases, highly polished surfaces are prepared and electrically illuminated in the Le Chatelier metallographic apparatus. The different ores can then be still further distinguished through careful etching; and recently artificial tarnishing has also been produced and used in the diagnosis. In this way it is possible to determine the order of deposition of the different minerals, and hence gain a valuable insight into their mode of origin.

The study of the platinum of the Urals might be cited. By this means, it was shown that the grains possess a zonal structure, such as is typical for crystals formed from a molten mass, as the augites in basalts or the feldspars in many porphyries. On the other hand, it was brought out that before the separation of the platinum, the separation of the chromite was already complete. Further, it could be shown in some cases where the platinum contained considerable osmium and iridium that crystals of osmiridium or newjanskite were scattered through the platinum trains, their separation taking place therefore between that of the chromite and that of the platinum. The last member of the sequence was always a silicate, olivine. All these observations established the segregation of the rare metal from the molten magma, also in those cases where the platinum occurred together with magnetite intergrown in a pyroxene rock. In the same way the origin of gold has been determined, such as the primary gold in the silicates of certain gabbro-diorites of Madagascar. If, on the other hand, the microscope discloses that, in any igneous rock whatever, native gold is found only where secondary quartz and pyrite occur, then the subsequent introduction of auriferous solutions must be assumed; this is the case in many of the supposedly primary gold-bearing diabases and epidiorites of Australia.

The theory of the magmatic origin of many oxidic chromium and iron ores was greatly fortified by means of the microscope. We know now with certainty that all workable chrome-iron ores were derived from magnesia-rich magmas. The origin of the gigantic ore deposits of Lapland was also worked out primarily through the use of the microscope, though aided by geological field investigations and boring operations conducted by the mining interests.

APPLICATION TO PROBLEM OF SUDBURY ORES.

The problem of the sulphides in the gabbros norites and diabases was more difficult. He who is familiar with the literature on the important deposit of Sudbury as well as that on the small occurrences at Sohland, on the Spree and Schluckenau, knows how difficult it was for geology to arrive at a generally accepted genetic conception of these ores. The microscope has shown that the old view of the magmatic nature of these ores applies to the extent that a part of the existing nickeliferous pyrrhotite and chalcopyrite actually must have segregated direct from the molten magma; and in the case of the great Canadian deposits this was by far the greater part. On the other hand, thin sections show that probably a thermal solution and redeposition of finely divided ore particles took place, giving rise to the formation of compact secondary masses of ore. A metamorphism of the rock preceded this redeposition, so that the secondary green hornblende, which is attached to the pyroxenes in delicate fringes, is in turn surrounded by pyrrhotite. The nickel content of the pyrrhotite is now also explained. The microscopy of highly polished surfaces established as true what had already been indicated as probable, through small-scale magmatic separation, namely, that there is an intimate mechanical intergrowth of common pyrrhotite and a nickel sulphide, pentlandite. The intergrowth is unfortunately so intimate that a commercial concentration is out of the question.

The modern conception of the next group, the contact metamorphic ore deposits, has been made possible largely through the microscope. Often the investigation of a single small sample of such ore suffices to make clear at once its genetic position, since structure and paragenesis are extremely characteristic here. Whoever knows how in accordance with the experience of the last decade the economic value of such contact metamorphic deposits has turned out in comparison with that of the magmatic or other types, will also know how to make commercial use of such a preliminary diagnosis when the occasion arises.

APPLICATION TO FIELD OF THE VEINS.

Within the field of the veins, one group of phenomena in particular has been elucidated, that concerning the replacement processes, or metasomatism. Of course, in certain vein-types these processes were understood in the pre-microscopic period as for example in the tin veins. Charpentier in his day pictured the steep-dipping tin veins of Geyer, which, together with the flat veins, are splendidly exposed, and he described very clearly how in the transition zones the feldspars of the granites were altered to gray quartz, besides cassiterite, arsenopyrite and other ores. The microscope, however, pointed out such phenomena in other vein groups with unexpected frequency. Only with its aid could we, for instance, understand the nature of sericitization, which is so widespread; and only thus were we able to recognize the same transformation along the courses of active thermal springs. It was found that replacement occurs not only in the country rock in place or included in the vein mass; but also in the vein material itself. The microscope decides whether the quartz is a primary deposit or whether silicic acid has subsequently replaced carbonate gangue minerals and barite, as at Schneeberg, or siderite, as in the Sieg district.

REPLACEMENT PROCESSES SHOWN AS OCCURRING IN EPIGENETIC DEPOSITS.

On a far larger scale the microscope has shown replacement processes to have occurred in stock-shaped and bedded, epigenetic deposits. Here, in particular, have thin sections proved, through the presence of fossils replaced by ore whether a cavity was formed and then filled with ore, or whether the original rock was replaced molecule by molecule with the metallic compounds.

There were problems of the greatest scientific and economic interest in the field of the epigenetic bedded deposits, in the solution of which no progress could have been made without the new method. Among others, the problem of the Witwaters and suggests itself here, calling for an abundance of nice investigations, part of which belong to the best known microscopic-petrographic achievements. The microscope soon showed that the early conception of this most famous gold deposit of the world as a complex of fossil gold placers, was erroneous. In its place, it gradually unfolded a picture of chemical-geological processes far more complicated than at first suspected.

These few suggestions indicate that the purely scientific progress attained by the

the ridge and the two bounding valleys it is pertinent to consider the condition of a concentration of solutions underneath the main drainage line of the basins rather than on the side of the basin; provided, of course, that the topography is sufficiently mature and has had time to permit the concentration of solutions under the central drainage lines, and further, that the copper solutions down the axis of the valley have not been diluted to the point that they will not precipitate in quantities sufficient to produce commercial orebodies.

TOPOGRAPHIC AND CLIMATIC CONDITIONS.

Topographic and climatic conditions are very important factors in the development of a commercially valuable disseminated copper deposit. Extreme youth of an area representative of original mineralization, when accompanied by intensive erosion of the surface, results in a very slow enrichment due to the fact that the necessary processes are not allowed to be completed before the material is removed; consequently, if enrichment is at all evident generally it is confined to the upper horizons and is merely superficial. Ordinary youthful topography, assisted by reasonably vigorous erosion of the surface, affords a better condition, while a thoroughly matured topography results in enrichment under the drainage lines. Influencing factors are changes in topography and general structure of the rock mass through subsequent regional earth movements, and it may happen that after a partial completion of enrichment over a given area that there has been a change which will afford either better or worse conditions relatively thereto.

An essential condition seems to be considerable variation in climate over long intervals of time. Semi-arid to arid climates afford satisfactory conditions under certain circumstances. Wide variation of temperature and sufficient moisture accompanied by relatively high temperatures accelerate decomposition of the exposed surface. In this connection it is pertinent to observe that these conditions are the more nearly met in the semi-arid or arid regions than elsewhere, chiefly at altitudes ranging from 4,000 feet and upward above sea level.

PHYSICAL AND CHEMICAL CONDITIONS.

Rock composition generally is the controlling factor governing secondary sulphide enrichment. Dependent upon the power of resistance to physical disintegration orebodies will be formed relatively to the structural conditions surrounding the rock mass. If the intrusive igneous rock, or its metamorphic derivatives, present a compact, unyielding mass not readily amenable to the weathering agencies, it is not likely that enrichment will extend to any great depth; in fact, there will be little or no change in the original mineralization as represented therein. On the other hand, where the rock mass presents a physical structure susceptible to disintegration through weathering processes the condition then is conducive to the formation of secondary sulphide deposits. This is best illustrated, perhaps, by the fact that, where the composition of a rock mass of original mineralization is such that it is subjected to physical disintegration and chemical alteration by exposure to weathering agencies, the exposed portion containing original minerals will be thoroughly oxidized and the copper mineral content thereof in part carried to a lower horizon as an enrichment product, leaving a leached zone of barren capping on the surface proportionate to the intensity of oxidation.

Where conditions are favorable, and the original mineralization carried a relatively high iron pyrite content, it is not unusual to note outcrops of leached areas of capping, or barren rock, composed chiefly of impure hematite representative of the superficial alteration of the exposed surface of the mineral deposit. Generally the more hematite the capping shows, the more iron sulphide will be found in the fresh ore at a lower horizon. Often the residual products of pyrite oxidation are carried by surface waters into adjoining porous rocks impregnating them to the extent that they simulate the original leached area. It follows, therefore, that the apparent area of superficial alteration represented by the iron capping does not indicate the existence thereunder of an enriched zone, only as referred to the original copper mineral content of the mass relatively to the structural conditions obtaining.

Altered areas represented by iron capping do not invariably indicate zones of copper sulphide enrichment, nor is it necessary that there be present any iron capping whatever, as many large deposits show merely inconspicuous outcrops of rotted rock. Finally the principal conditions necessary are the mineralization of the original rock mass; the physical structure thereof; topographic and climatic conditions favorable to the complete degradation and transportation by progressive action of the copper minerals in solution to a lower horizon, there to be precipitated either upon leaner pyrite in the formation of workable bodies of secondary sulphide enrichment, or else, in the absence of primary pyrite, as secondary carbonates and silicates.

GENERAL CHEMICAL PROCESS.

The oxidation of a deposit of sulphide ores is practically the same regardless of the form or character of the deposit. The solution of the sulphides generally is in the nature of sulphates, resulting in the precipitation of the metals at a lower horizon in the form of secondary sulphides. The reduction of the sulphates to metallic sulphides may be accomplished by several different processes, but most frequently by carbonaceous matter, precipitation by hydrogen sulphide, or the reaction of the metallic salts with the unoxidized sulphides below water level; in which event the latter go into solution as sulphates (or other salts), the former precipitating as sulphides.

The first reaction considers that of the oxidation of the original sulphides. Aside from the exposure thereof to the action of atmospheric oxygen and moisture, strong oxidizing agents, such as ferric salts, play an important role. Relative resistance to oxidation and solution is an important contributing factor, and it may happen that chemical action is slower than the physical in which event the partially decomposed original product might be carried away before its contained copper content has been thoroughly leached and carried downward. Further, the chemical and physical composition of the gangue minerals may be such as to make them exclusively the determining factors.

IRON SULPHIDE A FACTOR.

Where pyrite is the predominating sulphide of the original mineralization its products of oxidation are particularly essential as reagents in the enrichment process. There are several ways by which reduction of the pyrite to ferrous sulphate is accomplished: (a), by oxidation solely by atmospheric oxygen, resulting in the formation of ferrous sulphate and free sulphur; (b), reduction to ferrous sulphate, and formation of sulphur dioxide, and (c), a more complete reduction by combined free oxygen and water to the ferrous sulphate and sulphuric acid. In the presence of an excess of sulphuric acid the ferrous sulphate, assisted by free oxygen, results in a further reduction to ferric sulphate. Ferric sulphate, however, is unstable near the surface, but at lower horizons (and assisted by other ferric salts) becomes an active oxidizing solution. Consequently the instability of ferric sulphate near the surface, and the active evaporation attending its presence, results in its forming a product consisting of the various hydrated

oxides of iron. The oxidizing action of ferric sulphate at lower horizons in the presence of water results in its breaking up into two molecules of ferrous sulphate, one of sulphuric acid, and a free atom of oxygen to attack oxidizable substances.

Considering the chemical changes that would take place when copper sulphate comes into contact with iron sulphide, the copper sulphate is reduced to cupric sulphide with the formation of ferric sulphate and the liberation of free sulphur, the ferric sulphate would in turn easily be reduced by hydrogen sulphide or free sulphur. The presence of hydrogen sulphide, resulting from the attack of free sulphuric acid on pyrite would result in the formation of the cuprous sulphide. However, in the direct formation of cuprous sulphide from an assumed solution of copper sulphate it probably would be more reasonable to consider the reactions as obtaining only between copper sulphate, iron sulphide and water; in which event a direct reduction to cuprous sulphide would be brought about with the formation of ferrous sulphate and sulphuric acid with no liberation of free sulphur. The exact chemical reactions governing secondary enrichment will never be written, but some light may be shed on the subject by means of the results obtained in laboratory experiments.

Little attention has been given the subject of the important influence of sphalerite as an active mineral constituent in the chemical reactions governing sulphide enrichment. That it plays a very important role in the case of many of the "porphyries" is well known, but investigations have not been sufficiently thorough to afford much data on the subject.

While thus far we have considered only the relative reactions between metallic sulphides, if we assume the solutions of the original leached area to have been copper bicarbonate instead of copper sulphate results will be obtained wherein the iron will form as a carbonate in lieu of sulphate. However, if the downward percolating solutions carrying copper carbonate do not encounter sulphide precipitants they will not form sulphide deposits at any depth. In consideration of this it will readily be appreciated that the chemical reactions governing the process may be acid, basic, or neutral and as there is no fixed rule in connection with the formation of downward sulphide enrichment deposits other than that above outlined each individual deposit must be considered independently.

Sand Filling As Support Of Mine Workings

By Al H. MARTIN.

The extraction of pillars of rich ore, and permanent support of the old workings, has been a problem for most mine managers from the days of comprehensive lode mining. The most general practice has been the close timbering of heavy ground with expensive timbers, but this has prevented in most instances the subsequent mining of portions of the ground, and compelled the management to abandon numerous pillars of rich quartz, as the timbers have needed the support of the column of rock to sustain the tremendous weight of the hanging-wall. Not only has the adequate support of the underground workings compelled the constant attention of the manager during the active life of the property, but even after the passing of its productive period, because of surface disturbances. The subsidence of the old mine workings has often endangered portions of towns and cities, and legislation has been frequently threatened against the mine owners to prevent trouble of this character.

The finest grade of timber is certain to weaken and collapse under the crushing strain of millions of tons of settling earth in the course of years even when supporting pillars are permitted to carry the greater portion of the strain. In many of the Rand mines, and numerous American properties, it has been found that the ore pillars show decided signs of crushing after carrying the prodigious weight for some years, even with the reinforcement of close sets of timbers. This is particularly marked when the vein-system has a fairly steep dip. Various expedients have been proposed to overcome the problem, and in several instances efforts have been made at its solution by employment of steel timbers, and reinforced concrete supports. Objections to such practices have developed, but the method has generally proved satisfactory when compared with old-time provisions.

It has fittingly remained for the great Rand mining field of the Transvaal to devise and perfect a method at once satisfactory and inexpensive—a method that has so convincingly demonstrated its merit that its use is becoming general throughout the greatest gold field of the world. On the Rand mining is conducted on a stupendous scale hardly appreciated in other fields, and the question of adequately supporting the mine workings at low costs has developed into a vital consideration. Practically all the premier companies have devoted special attention to the subject and after years of systematical experiments sand-filling has been selected as the ideal solution of the vexing question. The employment of the method has been particularly marked during the past two years, and its use is making rapid advances throughout the entire field. The success of the experiment on the Rand has claimed some attention from American operators, but is deserving of a better reception than has been generally extended it on this side of the hemisphere. American mine managers are proverbially slow to adopt the practices developed in foreign fields, which may account for the apparent indifference accorded the method developed by the Transvaal operators.

One of the most successful of the sand-filling plants on the Rand is that operated by the Witwatersrand Deep, Ltd., which has been in commission about eight months. The plant was designed after the method had been thoroughly tried out by several other operators, and embodies all the good features of earlier installations, together with many original improvements of merit. The mill of this company crushes about 38,000 tons of ore per month and 60 per cent of the reduced product is sand, or approximately 22 000 tons. All of this is turned back into the mine for filling of the old stopes and other workings. The Witwatersrand Deep claims are traversed by the great East Rand dike which practically cuts the property into north and south sections. In both portions of the mine sand-filling is proceeding, and not only has it facilitated removal of the rich pillars hitherto employed as supporting agents, but also enables the operators to mine large areas of ground formerly inaccessible under ordinary working conditions. The sand is sent from the surface into the northern portion of the mine through a hole bored for the purpose, and the south section is supplied by way of a winze.

METHODS EMPLOYED ON THE RAND.

At the receiving terminals are placed rows of tanks commanding belt-conveyors. These deliver the product of two

the current period, which might be more or less than the current construction or equipment costs

The matter of deferred charges is probably the most difficult question in mine accounting. Briefly, it is the question of what operating costs are to be stated against future as distinguished from current product. It is manifest that the cost of mining and transportation for ore on hand in the mill bins at the end of the month is not properly a part of the cost of the mill product for that month, but is a charge which should be deferred until it can be stated as a part of the cost of the product resulting from that ore. It is also a fairer measure of cost to apply the cost of stripping proportionately to the tonnage made available than to charge against current production the stripping done during that period. These, and other more difficult features, are primarily engineering questions, the answers to which must come from the facts in the case, rather than from accounting methods.

What the accounts should show clearly and definitely is the amount of expenditures for capital accounts or deferred charges, the amounts charged against operations and the basis on which the charges have been made.

WHAT OPERATING COSTS SHOULD SHOW.

A summary of operating costs may therefore be shown as follows:

Direct charges to operating accounts for labor, materials and sundry expenses;

Add charges for the proportion of distributing accounts which apply to current operation;

Giving the total current operating costs;

Add depreciation;

Add previous deferred charges applying to current production;

Deduct any current costs which are to be deferred charges against future production;

Gives total cost chargeable against current production.

The corresponding summary for capital accounts would be:

Balance of capital accounts at the first of the period;

Add current charges to capital accounts (being the direct charges for labor, materials and sundry expenses, plus the proportionate charges from distributing accounts, if any);

Deduct depreciation chargeable to operating accounts;

Gives balance of capital accounts at the end of the period.

A summary of deferred charges would be along the same lines.

PRODUCTION RECORDS.

The details of production records will be determined almost entirely by the character of the ore and its treatment, and the manner of its sale. They should be such as will clearly follow the movement of the product from the ore mined to the ore, concentrates or metals sold, giving all the important information from stage to stage. Although the ledger accounts only take up the facts which can be expressed in dollars and cents, there is such a close relation between the metallurgical data and the final value of the product as to form a single, continuous set of records to correspond to the progress of the ore.

At first the ore simply stands in the accounts as representing its cost to the stage it has reached. Finally, however, it reaches the point where it is to be taken into the accounts at the value of its metallic content which is in marketable shape. The distinction must be made between the gross value of the metallic content, the amount of metal which will be paid for, and the net amount to be received after deducting the charges for treatment, transportation, etc.

Although the general law is that profit can only be considered as earned when an actual sale is made, it is customary in mine accounts to consider the profits when the product reaches its marketable form, as ore, concentrates or bullion ready for shipment. The advantage of having the clear statement of what the mine is doing more than balance the comparatively slight variations which will result from the use of mine assays and estimated marketing expenses.

SUMMARY OF THE PRODUCTION RECORDS.

The summary of production, on this basis, would be as follows:

Gross value of production;

Less smelter deductions, treatment and freight;

Gives net settlement value of production.

If, as is usually the case, part of this production is on hand, in transit or at smelters and not yet paid for, there would also be a summary to show;

Production for the period;

Product on hand, in transit and at smelters at the first of the period;

Giving total production to be accounted for;

Less production settled for during the period;

Leaves the product on hand, in transit and at smelters at the end of the period (which would agree with the total of the individual lots of unmarketed product).

PROFIT AND LOSS.

While one purpose of the cost and production records has been to show from an operating standpoint the costs per ton, foot, yard, etc., and the recoveries from ores, these same records should lead to the balancing of production against cost, to show the profit It will be recognized that this is practically nothing more than a grouping of the summaries previously given.

The profit is not the difference between the cash received from production sold and the cash disbursed in payment of bills.

As already pointed out, consideration must be given on the one hand to the production not yet settled for, and on the other hand, not merely to the distinction between cash paid out and expenses incurred, but also to the questions of capital and deferred charges and the cost which is properly chargeable against current production.

In addition to the profit from mining operations, there will usually be certain miscellaneous items such as rentals, store sales, etc. Although these may sometimes be of such importance to require a complete set of accounting records for each, such accounts will merely follow the ordinary commercial methods, showing the resulting profit or loss.

SUMMARY OF PROFIT AND LOSS ACCOUNT.

The summary of profit and loss may accordingly give:

Gross value of production.

Less cost of production.

Less smelter deductions, treatment and freight

Giving mining profit and loss.

Add or deduct miscellaneous profits or losses.

Giving net profit or loss for the period.

Add the balance of profits at the beginning of the period.

Deduct dividends paid.

Gives the balance of profits remaining at the end of the period.

ASSETS AND LIABILITIES.

The general divisions of assets and liabilities have already been referred to. Under the divisions will appear such ac-accounts as the conditions in each case may call for. The exact title to be used for each account is of comparatively little importance, so long as it signifies clearly the nature and scope of the account, and so long as the accounts are so carried that the value of each and its relations to other accounts will be readily apparent.

In addition to the accounts for actual indebtedness which will appear on the liability side of a financial statement, there will also be the accounts for reserves, capital stock and surplus. Re-

IN THIS ISSUE.

Mining and Scientific Press on "Recent Problems in Copper Production."

Salt Lake City, Utah
OCTOBER, 1911

Single Copies, 10c; $1 a Year
VOLUME III, No. 2